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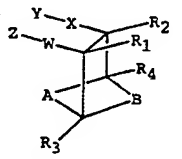
(54) Title: BICYCLOOCTANE AND BICYCLOHEPTANE DERIVATIVES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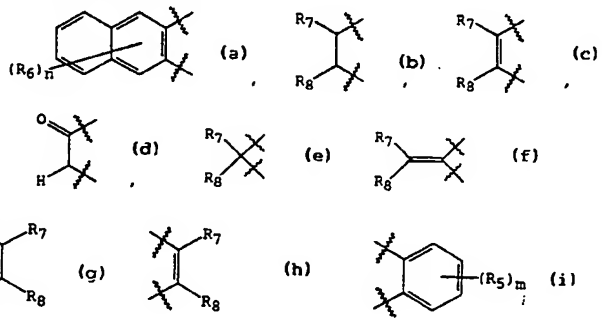
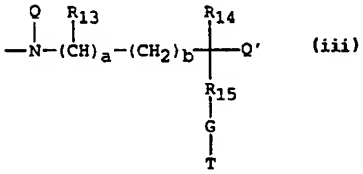

(a) (b) (c) (d) (e) (f) (g) (h) (i)

(i)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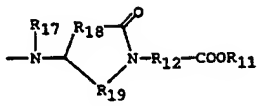
(iv)

(57) Abstract

Compounds of formula (I), wherein A is selected from (a), (b) (c), (d), (e), (f) and B is selected from (g), (h) and (i), wherein W is a carbonyl, sulphonyl or sulphinyl group, and X is a carbonyl, sulphonyl or sulphinyl group or $-C(O)-CH_2-$ (in which the carbonyl group is bonded to Y), provided that at least one of W and X contains carbonyl, Y is R_9-O- or $R_9-N(R_{10})-$, Z is selected from (i), (ii), (iii), (iv) or Z is absent and W is H, with a number of provisions and pharmaceutically acceptable salts thereof are ligands at CCK and/or gastrin receptors.

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BICYCLOOCTANE AND BICYCLOHEPTANE DERIVATIVES

This invention relates to bicyclooctane and bicycloheptane derivatives, and more particularly to bicyclooctane and bicycloheptane derivatives which bind to cholecystokinin and/or gastrin receptors. The invention also relates to methods for preparing such bicyclooctane and bicycloheptane derivatives and to compounds which are useful as intermediates in such methods.

Gastrin and the CCK's are structurally-related neuropeptides which exist in gastrointestinal tissue and in the CNS (see Mutt V., Gastrointestinal Hormones, Glass G.B.J., ed., Raven Press, N.Y., p 169 and Nisson G., ibid, p. 127).

Gastrin is one of the three primary stimulants of gastric acid secretion. Several forms of gastrin are found including 34-, 17-, and 14-amino acid species with the minimum active fragment being the C-terminal tetrapeptide (TrpMetAspPhe-NH_2) which is reported in the literature to have full pharmacological activity (see Tracey H.J. and Gregory R.A., Nature (London), 1964, 204, 935). Much effort has been devoted to the synthesis of analogues of this tetrapeptide (and the N-protected derivative Boc-TrpMetAspPhe-NH_2) in an attempt to elucidate the relationship between structure and activity.

Natural cholecystokinin is a 33 amino acid peptide (CCK-33), the C-terminal 5 amino acids of which are identical to those of gastrin. Also found naturally is the C-terminal octapeptide (CCK-8) of CCK-33.

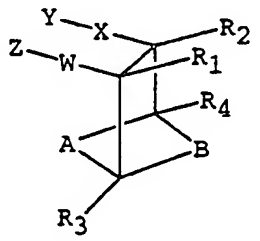
The cholecystokinins are reported to be important in the regulation of appetite. They stimulate intestinal motility, gall bladder contraction, pancreatic enzyme secretion, and are known to have a trophic action on the pancreas. They also inhibit gastric emptying and have various effects in the CNS.

Compounds which bind to cholecystokinin and/or gastrin receptors are important because of their potential pharmaceutical use as antagonists of the natural peptides.

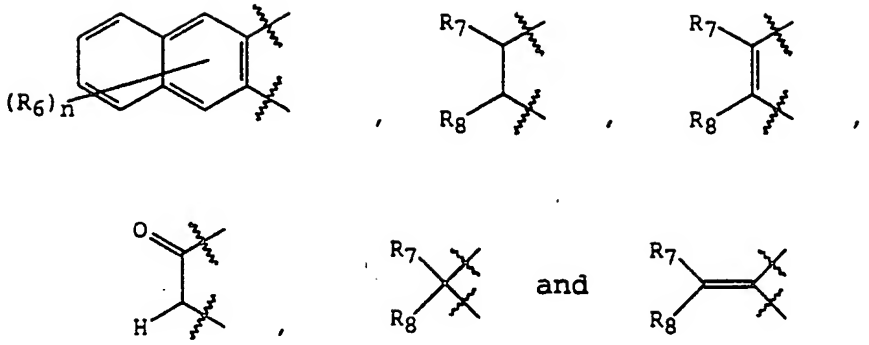
A number of gastrin antagonists have been proposed for various therapeutic applications, including the prevention of gastrin-related disorders, gastrointestinal ulcers, Zollinger-Ellison syndrome, antral G cell hyperplasia and other conditions in which lowered gastrin activity is desirable. The hormone has also been shown to have a trophic action on cells in the stomach and so an antagonist may be expected to be useful in the treatment of cancers, particularly in the stomach.

Possible therapeutic uses for cholecystokinin antagonists include the control of appetite disorders such as anorexia nervosa, and the treatment of pancreatic inflammation, biliary tract disease and various psychiatric disorders. Other possible uses are in the potentiation of opiate (e.g. morphine) analgesia, and in the treatment of cancers, especially of the pancreas. Moreover, ligands for cholecystokinin receptors in the brain (so-called CCK_B receptors) have been claimed to possess anxiolytic activity.

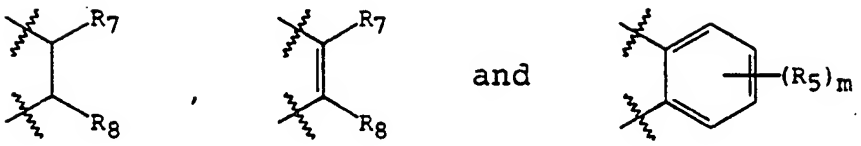
According to the present invention, there are provided compounds of the formula



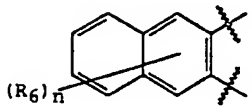
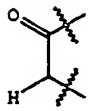
wherein A is selected from

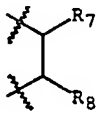
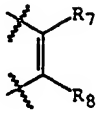


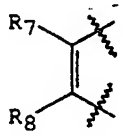
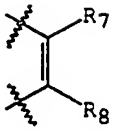
and B is selected from



(provided that

A is not  or 

when B is  or  , and

A is not  when B is )

wherein W is a carbonyl, sulphonyl or sulphinyl group, and

X is a carbonyl, sulphonyl or sulphinyl group or $-C(O)-CH_2-$ (in which the carbonyl group is bonded to Y), provided that at least one of W and X contains carbonyl,

Y is R_9-O- or $R_9-N(R_{10})-$ (wherein R_9 is H or C_1 to C_{15}

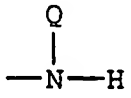
hydrocarbyl, up to two carbon atoms of the hydrocarbyl moiety optionally being replaced by a nitrogen, oxygen or sulphur atom provided that Y does not contain a -O-O- group, and R_{10} is H, C_1 to C_3 alkyl, carboxymethyl or esterified carboxymethyl),

Z is selected from

i) $-O-R_{11}$

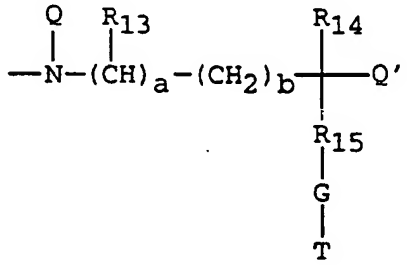
wherein R_{11} is H, C_1 to C_5 alkyl, phenyl, substituted phenyl, benzyl or substituted benzyl;

ii)



wherein Q is H, C_1 to C_5 hydrocarbyl, or $-R_{12}-U$, wherein R_{12} is a bond or C_1 to C_3 alkylene and U is aryl, substituted aryl, heterocyclic, or substituted heterocyclic,

iii)



wherein a is 0 or 1 and b is from 0 to 3,

R_{13} is H or methyl,

R_{14} is H or methyl; or R_{14} is $CH_2=$ and Q' is absent; or R_{13} and R_{14} are linked to form a 3- to 7-membered ring,

R_{15} is a bond or C_1 to C_5 hydrocarbylene,

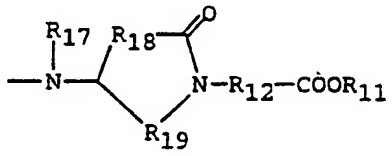
G is a bond, -CHOH- or -C(O)-

Q' is as recited above for Q or $-R_{12}-(C(O))_d-L-(C(O))_e-R_{11}$ (wherein R_{11} and R_{12} are as defined above, L is O, S or $-N(R_{16})-$, in which R_{16} is as defined above for R_{10}, and d and e are 0 or 1, provided that d+e<2); or Q' and R_{14}, together with the carbon atom to which they are attached, form a 3- to 7-membered ring,

Q is as defined above; or Q and R_{14} together form a group of the formula $-(CH_2)_f-V-(CH_2)_g-$ wherein V is -S-, -S(O)-, $-S(O)_2-$, $-CH_2-$, -CHOH- or -C(O)-, f is from 0 to 2 and g is from 0 to 3; or, when Q' is $-R_{12}-U$ and U is an aromatic group, Q may additionally represent a methylene link to U, which link is *ortho* to the R_{12} link to U,

T is H, cyano, C_1 to C_4 alkyl, $-CH_2OH$, carboxy, esterified carboxy, amidated carboxy or tetrazolyl; or

iv)



wherein R_{11} and R_{12} are as defined above, R_{17} is as defined above for R_{10}, and R_{18} and R_{19} are independently a bond or C_1 to C_3 alkylene, provided that R_{18} and R_{19} together provide from 2 to 4 carbon atoms in the ring,

or Z is absent and W is H,

R_1 is H, methyl, halo, carboxy, esterified carboxy, amidated carboxy, tetrazolyl, carboxymethyl, esterified carboxymethyl, amidated carboxymethyl or tetrazolylmethyl,

R_2 is selected from the groups recited above for R_1; or, when Z is absent and W is H, R_2 may additionally represent -C(O)-Z' wherein Z' is selected from the groups recited above for Z; or R_1 and R_2 together form a second bond between the carbon atoms to which they are attached,

R_3 and R_4 are independently selected from hydrogen, halo, amino, nitro, cyano, sulphamoyl, C_1 to C_3 alkyl, C_1 to C_3 alkoxy, carboxy, esterified carboxy, amidated carboxy or tetrazolyl,

R_5 and R_6 (or each R_5 and R_6 group, when m or n is 2 or more) are independently selected from halo, amino, nitro, cyano, sulphamoyl, C_1 to C_3 alkyl, C_1 to C_3 alkoxy, carboxy, esterified carboxy, amidated carboxy or tetrazolyl,

R_7 and R_8 are independently selected from hydrogen, C_1 to C_6 alkyl, phenyl, benzyl, substituted phenyl and substituted benzyl,

m is from 0 to 4, provided that m is not more than 2 unless R_5 is exclusively halo,

n is from 0 to 4, provided that n is not more than 2 unless R_6 is exclusively halo,

and pharmaceutically acceptable salts thereof.

The compounds of the invention exist in various enantiomeric and diastereomeric forms as a result of the asymmetric carbon atoms to which W and X are attached. It will be

understood that the invention comprehends the different enantiomers and diastereomers in isolation from each other, as well as mixtures of enantiomers. Also, the structural formulae herein show the groups W and X arranged *cis* to each other, but it will be appreciated that the invention includes the corresponding *trans* isomers. Similarly, the invention includes the different regioisomers which result from W and X being arranged in different configurations relative to A. That is to say, the invention comprehends both the exo and the endo isomers of the compounds represented by the above formula. In this specification, the designation exo and endo is determined by the convention described in "Vocabulary of Organic Chemistry", Orchin *et al* (eds.), Wiley, New York (1980) p141. For example, in the benzo-fused compounds of the invention, the exo isomer has the 7 and 8 substituents on the opposite side of the molecule to this aromatic ring.

The term "hydrocarbyl", as used herein, refers to monovalent groups consisting of carbon and hydrogen. Hydrocarbyl groups thus include alkyl, alkenyl, and alkynyl groups (in both straight and branched chain forms), cycloalkyl (including polycycloalkyl), cycloalkenyl, and aryl groups, and combinations of the foregoing, such as alkylaryl, alkenylaryl, alkynylaryl, cycloalkylaryl, and cycloalkenylaryl groups,

A "carbocyclic" group, as the term is used herein, comprises one or more closed chains or rings, which consist entirely of carbon atoms. Included in such groups are alicyclic groups (such as cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl and adamantyl), groups containing both alkyl and cycloalkyl moieties (such as methyl adamantyl), and aromatic groups (such as phenyl, naphthyl, indanyl, fluorenyl, (1,2,3,4)-tetrahydronaphthyl, indenyl and isoindenyl).

The term "aryl" is used herein to refer to aromatic carbocyclic groups, including those mentioned above.

A "heterocyclic" group comprises one or more closed chains or rings which have at least one atom other than carbon in the closed chain or ring. Examples include thienyl, furanyl, pyrrolyl, imidazolyl, pyrazolyl, thiazolyl, isothiazolyl, oxazolyl, pyrrolidinyl, pyrrolinyl, imidazolidinyl, imidazolinyl, pyrazolidinyl, tetrahydrofuranyl, pyranyl, pyronyl, pyridyl, pyrazinyl, pyridazinyl, piperidyl, piperazinyl, morpholinyl, thionaphthyl, benzofuranyl, isobenzofuryl, indolyl, oxyindolyl, isoindolyl, indazolyl, indolinyl, 7-azaindolyl, isoindazolyl, benzopyranyl, coumarinyl, isocoumarinyl, quinolyl, isoquinolyl, naphthridinyl, cinnolinyl, quinazolinyl, pyridopyridyl, benzoxazinyl, quinoxadinyl, chromenyl, chromanyl, isochromanyl and carbolinyl.

The term "halogen", as used herein, refers to any of fluorine, chlorine, bromine and iodine. Most usually, however, halogen substituents in the compounds of the invention are chlorine or fluorine substituents.

When reference is made herein to a "substituted" aromatic group, the substituents will generally be from 1 to 3 in number (and more usually 1 or 2 in number), and selected from the groups recited above for R_5.

Preferably, m and n are both 0. However, when m and n are not both 0, R_5 and R_6 are preferably selected from halo, amino, nitro, cyano, sulphamoyl, C_1 to C_3 alkyl and C_1 to C_3 alkoxy. As mentioned above, when m or n is 2 or more, each R_5 and R_6 group is independent of the others. For example, the compounds of the invention may include two different R_5 groups.

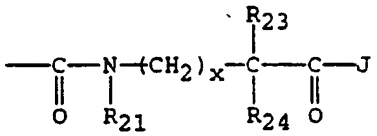
Particularly preferred groups for R_3 and R_4 are hydrogen and the groups just recited for R_5, and especially hydrogen, methyl and fluoro.

An "esterified" carboxy group, as the term is used herein,

is preferably of the form $-COOR_{20}$, wherein R_{20} is C_1 to C_5 alkyl, phenyl, substituted phenyl, benzyl, substituted benzyl, or one of the following:

Most commonly, R_{20} is C_1 to C_5 alkyl, benzyl or substituted benzyl, and particularly C_1 to C_5 alkyl. Similarly, an "amidated" carboxy group is preferably of the form $-CONR_{21}R_{22}$ wherein R_{21} and R_{22} are independently H, C_1 to C_5 alkyl, phenyl, substituted phenyl, benzyl or substituted benzyl.

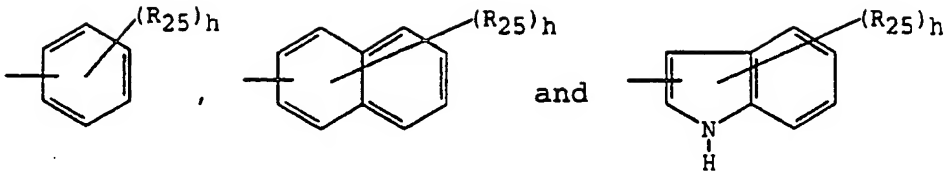
In the case of the group T, preferred amidated carboxy groups take the form $-CONR_{21}R_{22}$ (wherein R_{21} and R_{22} are as defined above) or



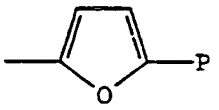
wherein R_{21} is as defined above, R_{23} and R_{24} are independently H or methyl, or R_{23} and R_{24} (together with the carbon atom to which they are attached) form a 3- to 7-membered carbocyclic group, J is $-OH$, $-O-R_{20}$ or $-NHR_{22}$, wherein R_{20} and R_{22} are as defined above, and x is 0 to 3.

When R_{13} and R_{14} are linked to form a ring, such ring will generally be saturated, and usually also carbocyclic. Similarly, when Q' and R_{14} are linked to form a ring, this will also usually be saturated and carbocyclic.

Exemplary carbocyclic and heterocyclic groups which may form the group U include:

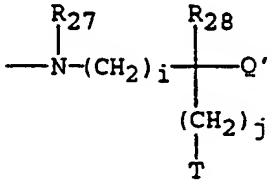


wherein R_{25} is as defined above for R_5, and h is from 0 to 3, and



wherein P is H or $-COOR_{26}$, in which R_{26} is as defined above for R_{21}.

Z is preferably $-NH_2$, $-O-R_{11}$ or



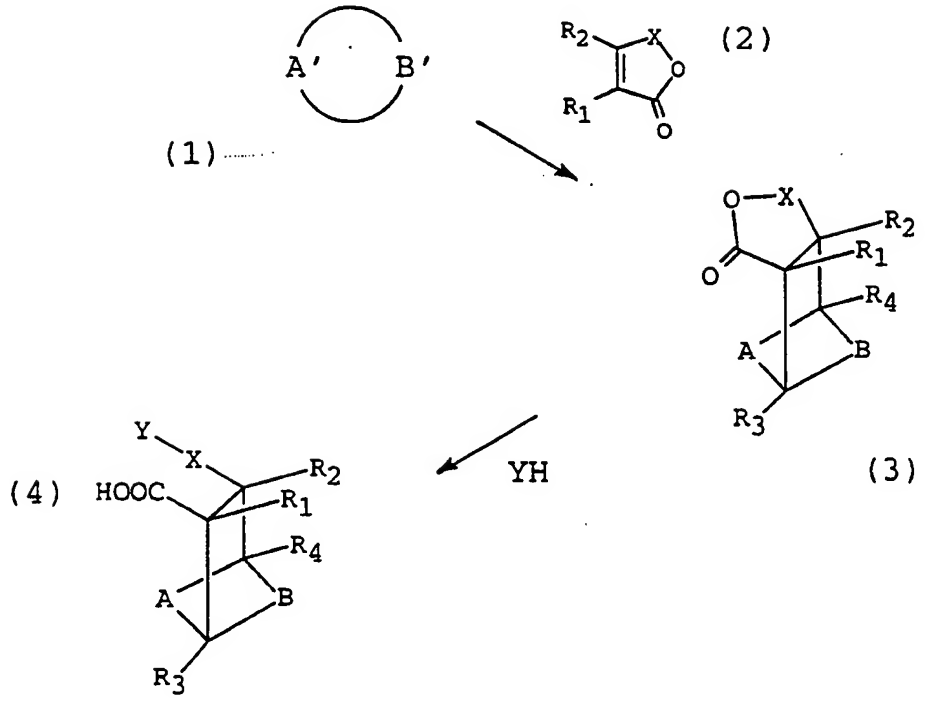
wherein i is from 0 to 4, j is from 0 to 3, R_{27} and R_{28} are independently H or methyl, or R_{27} and R_{28} together form a group of the formula $-(CH_2)_k-V'-CH_2-$ (wherein V' is $-CH_2-$, -CHOH- or -C(O)-, and k is 0 to 2). Most commonly, i is 0 or 1 and j is 0 to 2.

When W is sulphinyl, Y is preferably R_9-NH-.

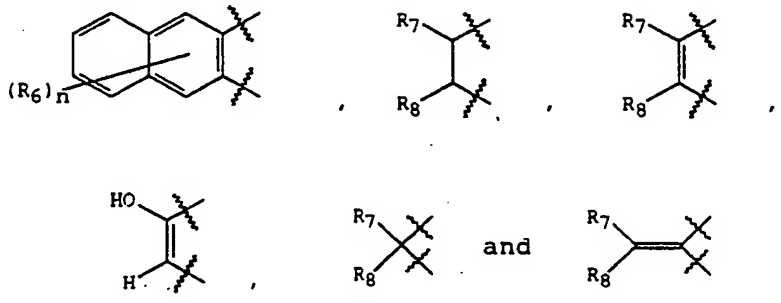
Preferably, R_9 is C_6 to C_8 straight or branched chain alkyl, or $R_{29}-(CH_2)_p-$, wherein R_{29} is selected from phenyl, 1-naphthyl, 2-naphthyl, indolyl, norbornyl, adamantyl or cyclohexyl, and p is from 0 to 3.

Compounds according to the present invention in which W is a carbonyl group, X is carbonyl or sulphonyl, and Z is OH may conveniently be made by the process depicted in Reaction Scheme A.

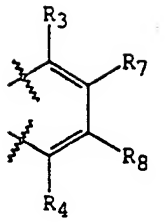
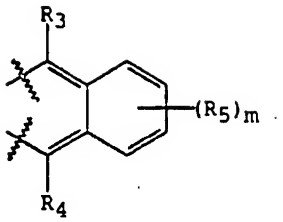
Reaction Scheme A



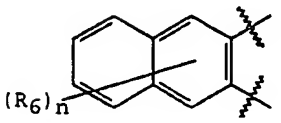
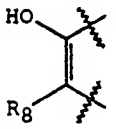
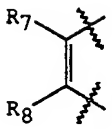
In this scheme, and in Reaction Schemes B, C and D below, A' is selected from

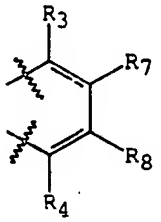


and B' is selected from

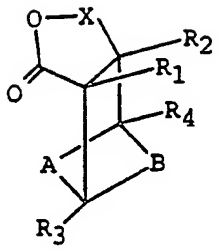
(provided that A' is not

when B' is ).

In Reaction Scheme A, compound (1) (e.g. naphthalene or 2,3-dimethylnaphthalene) is reacted with the acid anhydride (2) in a Diels-Alder reaction. The reactants are conveniently refluxed together in a suitable solvent such as toluene to form the adduct (3). In some cases, it may be appropriate to conduct the reaction at elevated pressure and/or in the presence of a Lewis acid catalyst. The adduct (3) is then reacted with a compound of the formula YH (ie. either an alcohol or an amine) to form the acid compound (4). If YH is an amine, the reaction is suitably carried out in a solvent such as THF in the presence of a catalytic amount of DMAP. If YH is an alcohol, the reaction may be conducted in pyridine at elevated temperature.

The invention therefore also provides a method of making compounds wherein W is carbonyl and X is carbonyl or sulphonyl, said method including the step of reacting a compound of the formula



with a compound of formula YH.

The equivalent *trans* adducts can be prepared using a suitably differentiated fumaric acid (eg. the mono methyl mono benzyl diester), which, after addition to compound (1), allows independent elaboration of the two side chains.

In those cases in which the Diels Alder reaction leads to a bicyclooctene or a bicycloheptene, the corresponding bicyclooctane or bicycloheptane can be obtained, if desired, by catalytic hydrogenation under appropriate conditions (preferably using a platinum catalyst), usually as the final step in the procedure.

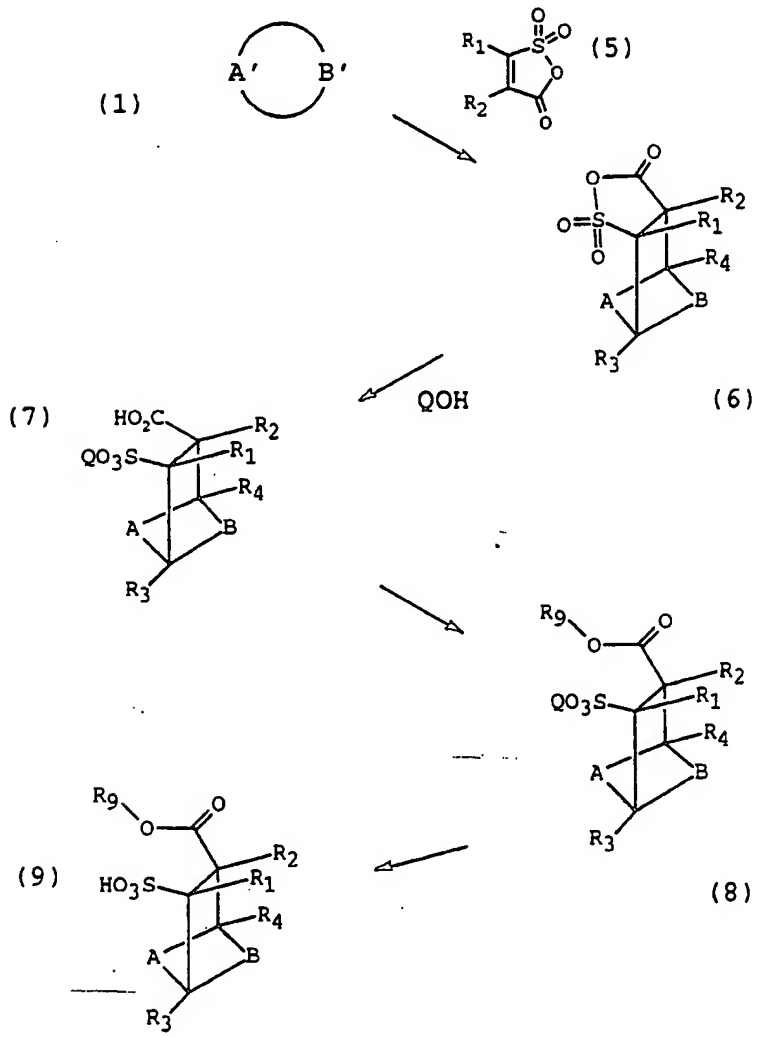
Compounds in which Z is other than OH may of course be made from the acid compound (4) by conventional esterification or amidation reactions. Suitable amidation methods are described in detail in "The Peptides, Vol. 1", Gross and Meinenhofer, Eds., Academic Press, N.Y., 1979. These include the carbodiimide method (using, for example, 1,3-dicyclohexylcarbodiimide [DCC] or 1-(3-dimethylaminopropyl)-3-ethylcarbodiimide hydrochloride [EDCI], and optionally an additive such as 1-hydroxybenzotriazole [HOBT] to prevent racemization), the azide method, the mixed anhydride method, the symmetrical anhydride method, the acid chloride method, the acid bromide method, the use of bis (2-oxo-3-oxazolidinyl) phosphinic chloride [BOP-Cl], the use of PyBOP, the use of the isopropenylsuccinimido carbonate method and the active ester method (using, for example, N-hydroxysuccinimide esters, 4-nitrophenyl esters or

2,4,5-trichlorophenol esters).

The coupling reactions are generally conducted under an inert atmosphere, such as an atmosphere of nitrogen or argon. Suitable solvents for the reactants include methylene chloride, tetrahydrofuran [THF], dimethoxyethane [DME] and dimethylformamide [DMF].

A procedure analogous to that shown in reaction scheme A may also be used as the basis for preparing the compounds of the invention in which W is sulphonyl and Y is R_9-O-, as depicted in reaction scheme B below:

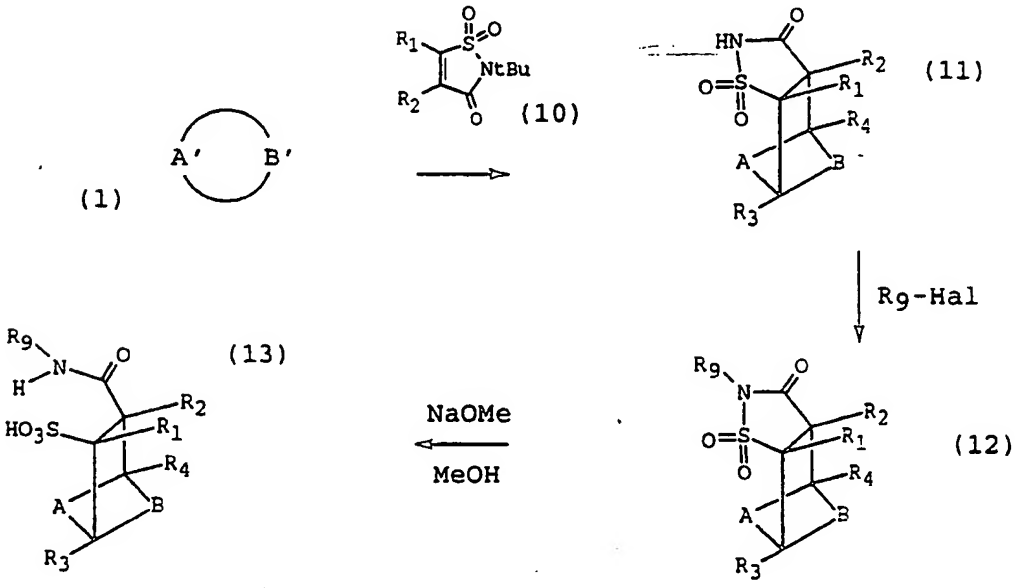
Reaction Scheme B



In this case, the Diels-Alder adduct (6) is opened with an alcohol such as benzyl alcohol (represented as QOH), so that product (7) is the corresponding sulphonyl ester. The free carboxylic acid group of this sulphonyl ester may then be esterified by conventional methods, followed by hydrogenolysis of the product (8) to yield the desired sulphonic acid carboxylic ester (9).

The compounds of the invention in which W is sulphonyl and Y is R_9-NH- may be prepared by analogous means, in which compound (7) is amidated (rather than esterified) prior to hydrogenolysis. Alternatively, a process such as is depicted in reaction scheme C may be employed:

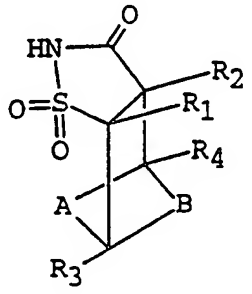
Reaction Scheme C



In this scheme, compound (1) is reacted with the N-protected compound (10) in a Diels-Alder reaction analogous to that of the first step in reaction scheme A. The deprotected product Diels-Alder adduct (11) is then reacted with a compound of the formula R_9-Hal (wherein Hal represents a

halogen atom) to form compound (12). The N-containing ring may then be opened using an alkoxide (eg. sodium methoxide in methanol) to produce the target compound (13).

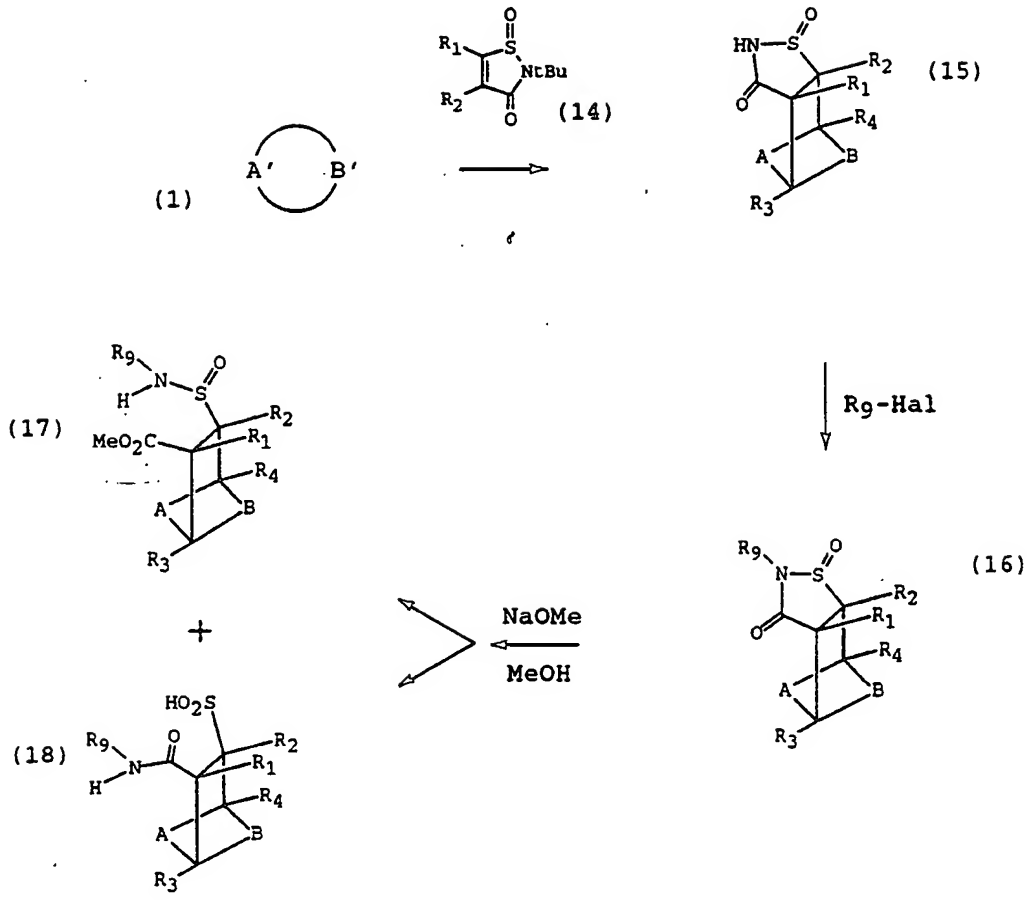
The invention therefore also provides a method of making compounds wherein W is sulphonyl and Y is R_9-NH-, said method comprising the step of reacting a compound of the formula



with a compound of the formula R_9-Hal, and then reacting the product with an alkoxide.

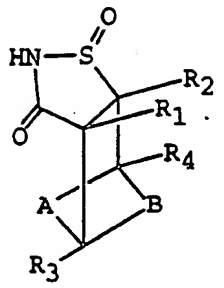
Compounds of the invention wherein W or X is a sulphoxide group may conveniently be prepared by the route shown in reaction scheme D:

Reaction Scheme D



Reaction scheme D is analogous to reaction scheme C, except that the sulphoxide analogue of compound (10) is used in the Diels-Alder reaction, to yield the sulphoxide analogue of adduct (12). This can then be opened both ways to give on the one hand the sulphinamide acid alkyl ester (17), and on the other the sulphinic acid amide (18). The free sulphinamide acid can of course be obtained from the alkyl ester (12) by conventional methods.

Accordingly, the invention also provides a method of making compounds wherein W or X is sulphoxide, said method comprising the step of reacting a compound of the formula:



with a compound of the formula R_9-Hal, and then reacting the product with an alkoxide.

While reaction schemes C and D above lead to the free sulphonic or sulphinic acid compounds, it will be appreciated that the corresponding ester or amide derivatives can be prepared from the free acid compounds by conventional methods. Most usually, coupling of the sulphonic or sulphinic acid compounds will be *via* the corresponding sulphonic or sulphinic acid chlorides.

Pharmaceutically acceptable salts of the acidic or basic compounds of the invention can of course be made by conventional procedures, such as by reacting the free base or acid with at least a stoichiometric amount of the desired salt-forming acid or base.

The compounds of the invention can be administered by oral or parenteral routes, including intravenous, intramuscular, intraperitoneal, subcutaneous, rectal and topical administration.

For oral administration, the compounds of the invention will generally be provided in the form of tablets or capsules or as an aqueous solution or suspension.

Tablets for oral use may include the active ingredient mixed with pharmaceutically acceptable excipients such as inert diluents, disintegrating agents, binding agents, lubricating

agents, sweetening agents, flavouring agents, colouring agents and preservatives. Suitable inert diluents include sodium and calcium carbonate, sodium and calcium phosphate, and lactose, while corn starch and alginic acid are suitable disintegrating agents. Binding agents may include starch and gelatin, while the lubricating agent, if present, will generally be magnesium stearate, stearic acid or talc. If desired, the tablets may be coated with a material such as glyceryl monostearate or glyceryl distearate, to delay absorption in the gastrointestinal tract.

Capsules for oral use include hard gelatin capsules in which the active ingredient is mixed with a solid diluent, and soft gelatin capsules wherein the active ingredient is mixed with water or an oil such as peanut oil, liquid paraffin or olive oil.

For intramuscular, intraperitoneal, subcutaneous and intravenous use, the compounds of the invention will generally be provided in sterile aqueous solutions or suspensions, buffered to an appropriate pH and isotonicity. Suitable aqueous vehicles include Ringer's solution and isotonic sodium chloride. Aqueous suspensions according to the invention may include suspending agents such as cellulose derivatives, sodium alginate, polyvinyl-pyrrolidone and gum tragacanth, and a wetting agent such as lecithin. Suitable preservatives for aqueous suspensions include ethyl and n-propyl p-hydroxybenzoate.

The invention is now further illustrated by means of the following examples.

Example 1 Preparation of exo-(±)-cis-8-(1-adamantylmethyl-aminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene-7-carboxylic acid

a. exo and endo 5,6-benzobicyclo[2.2.2]oct-2-ene-7,8-dicarboxylic anhydride

Naphthalene (306.5 g, 2.39 mol) and maleic anhydride (469 g, 4.78 mol) were heated at 120° for 24h in a Parr bomb. After reaction the mixture was poured into water and the insoluble material filtered and dried. The dry solid was dissolved in hexane and the insoluble material filtered, washed with hexane and dried in vacuo. The overall yield at this stage was 17.13 g (3.2%). The exo and endo regioisomers were separated by column chromatography (silica 30% ethyl acetate and 70% hexane) to give exo isomer (high R_f) 6.05 g, and endo isomer (lower R_f) 6.15 g.

b. exo-(±)-cis-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene-7-carboxylic acid

The exo isomer prepared in step a. (150 mg, 0.66 mmol) was dissolved in THF (10 ml) and 1-adamantylmethylamine (110 mg, 0.66 mmol) was added. The mixture was stirred at room temperature for 2h and the precipitate was filtered and washed with THF (10 ml) and hexane (20 ml) and dried to leave the title compound (0.253 g, 97%). The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 63.59; H, 8.12; N, 4.73. $C_{32}H_{46}N_2O_8 . 1.26H_2O$ requires C, 63.28; H, 7.72; N, 4.61%

Example 2 Preparation of endo-(±)-cis-8-(1-adamantylmethyl-aminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene-7-carboxylic acid

The compound was prepared essentially as in example 1 using the endo isomer (isolated in step a.) instead of the exo

isomer as the substrate in step b. for reaction with 1-adamantylmethylamine. Yield step b. 95%. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 63.04; H, 7.97; N, 4.50. $C_{32}H_{46}N_2O_8$. $1.32H_2O$ requires C, 62.95; H, 8.03; N, 4.59%

Example 3 Preparation of exo-(±)-cis-8-(1-cyclohexylmethyl-aminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene-7-carboxylic acid

This was prepared essentially as in example 1 but using cyclohexylmethylamine instead of 1-adamantylmethylamine in step b. Yield step b. 96%. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 61.88; H, 8.24; N, 5.01. $C_{28}H_{42}N_2O_8$. $0.57H_2O$ requires C, 61.72; H, 7.98; N, 5.14%

Example 4 Preparation of endo-(±)-cis-8-(1-cyclohexylmethyl-aminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene-7-carboxylic acid

This was prepared essentially as in example 2 but using cyclohexylmethylamine instead of 1-adamantylmethylamine in step b. Yield step b. 72%. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 62.82; H, 8.01; N, 5.07. $C_{28}H_{42}N_2O_8$ requires C, 62.90; H, 7.92; N, 5.24%

Example 5 Preparation of exo-(±)-cis-8-(octylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene-7-carboxylic acid

This was prepared essentially as in example 1 but using octylamine instead of 1-adamantylmethylamine in step b. Yield step b. 51%. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 63.19;

H, 8.61; N, 5.15. $C_{29}H_{46}N_2O_8$ requires C, 63.25; H, 8.42; N, 5.09%

Example 6 Preparation of endo-(±)-cis-8-(octylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene-7-carboxylic acid

This was prepared essentially as in example 2 but using octylamine instead of 1-adamantylmethylamine in step b. Yield step b. 58%. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 63.18; H, 8.59; N, 5.08. $C_{29}H_{46}N_2O_8$ requires C, 63.25; H, 8.42; N, 5.09%

Example 7 Preparation of exo-cis-7-(1-S-methoxycarbonylethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

The product of example 1 (200 mg, 0.51 mmol), PyBOP (266 mg) and diisopropylethylamine (0.267 ml, 1.53 mmol) were dissolved in dry dichloromethane and stirred at room temperature for 1h. L-alanine methyl ester hydrochloride (71 mg, 0.51 mmol) was added and the reaction mixture stirred at room temperature overnight. The reaction mixture was washed with 2M hydrochloric acid and filtered through a silica pad eluted with 20% ethyl acetate and dichloromethane (50 ml). The organic layer was evaporated in vacuo to yield the title compound as a colourless solid (109 mg, 45%). Found: C, 72.79; H, 7.63; N, 5.62. $C_{29}H_{36}N_2O_4$ requires C, 73.08; H, 7.61; N, 5.88%

Example 8 Preparation of endo-cis-7-(1-S-methoxycarbonyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

The compound was prepared essentially as in example 7 but using the product of example 2 as substrate instead of the product of example 1. Yield 43% Found: C, 71.10; H, 7.75; N, 5.49. $C_{29}H_{36}N_2O_4$. 0.78 H_2O requires C, 70.99; H, 7.72; N, 5.71%

Example 9 Preparation of exo-cis-7-(2-R-carboxyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylamino-carbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

a. exo-cis-7-(2-R-benzyloxycarbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

The reaction was performed essentially as in example 7 but using D-proline benzyl ester hydrochloride instead of L-alanine methyl ester hydrochloride. Yield 65%

b. exo-cis-7-(2-R-carboxy-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo-[2.2.2]oct-2-ene (mixture of diastereomers)

The product of step a. (150 mg, 0.26 mmol) was dissolved in ethanol and 10% palladium on charcoal (15 mg) was added. The reaction mixture was stirred under an atmosphere of hydrogen gas at room temperature overnight. The reaction mixture was filtered through a pad of celite and evaporated to give a gum. This material was redissolved in dichloromethane and on evaporation gave the title compound as a white solid. Yield 75% Found: C, 70.36; H, 7.83; N, 5.44. $C_{30}H_{36}N_2O_4$. 1.39 H_2O requires C, 70.15; H, 7.61; N, 5.45%

Example 10 Preparation of endo-cis-7-(2-R-carboxy-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

The compound was prepared essentially as in example 9 but using the product of example 2 instead of the product of example 1 in step a. Yield overall for steps a and b 60%. Found: C, 68.97; H, 7.55; N, 5.33. $C_{30}H_{36}N_2O_4$ requires C, 69.08; H, 7.66; N, 5.37%

Example 11 Preparation of exo-(±)-cis-8-(1-adamantylmethyl-aminocarbonyl)-2,3-dimethyl-5,6-benzobicyclo[2.2.2]oct-2-ene-7-carboxylic acid

a. exo and endo 2.3-dimethyl-5,6-benzobicyclo[2.2.2]oct-2-ene-7,8-dicarboxylic anhydride

2,3-dimethylnaphthalene (5.42 g, 35 mmol) and maleic anhydride (3.40 g, 35 mmol) were dissolved in dichloromethane (250 ml) and aluminium chloride (4.62 g, 35 mmol) was added. The reaction mixture was stirred at room temperature for 4h and then was poured onto ice. The two layers were separated and the dichloromethane layer was washed with saturated brine (3 x 100 ml) and then dried. This layer was evaporated to leave a yellow solid which was recrystallised from ether to give a 1:1 mixture of the endo and exo regioisomers. Column chromatography (silica 30% ethyl acetate and hexane) gave pure exo isomer (high R_f)(0.15 g) but no significant amounts of endo isomer could be isolated pure.

b. exo-(±)-cis-8-(1-adamantylmethylaminocarbonyl)-2,3-dimethyl-5,6-benzobicyclo[2.2.2]oct-2-ene-7-carboxylic acid

This was carried out essentially as described in example 1 step b. but using the exo anhydride isolated in step a.

above. Yield step b. 91%. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 64.38; H, 8.29; N, 4.31. $C_{34}H_{50}N_2O_8$. $1.06H_2O$ requires C, 64.42; H, 8.29; N, 4.42%

Example 12 Preparation of endo-(±)-cis-8-(1-adamantylmethylaminocarbonyl)-2,3-dimethyl-5,6-benzobicyclo[2.2.2]oct-2-ene-7-carboxylic acid

This was prepared essentially as in example 11 using the 1:1 exo:endo mixture prepared in step a. of example 11 rather than the pure exo regioisomer in step b. The desired endo isomer, the title compound, precipitated out of solution and was isolated by filtration and recrystallisation. Yield step b. 48%. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 64.54; H, 8.24; N, 4.39. $C_{34}H_{50}N_2O_8$. $0.98H_2O$ requires C, 64.57; H, 8.28; N, 4.43%

Example 13 Preparation of endo-(±)-cis-8-(1-adamantylmethylaminocarbonyl)-2-oxo-5,6-benzobicyclo[2.2.2]octane-7-carboxylic acid

a. endo (±)-2-oxo-5,6-benzobicyclo[2.2.2]oct-2-ene-7,8-dicarboxylic anhydride

2-Naphthol (20g, 0.14 mol) and maleic anhydride (18.0 g, 1.8 mol) were heated at 220° in a Parr apparatus for 30 min. On cooling ethyl acetate (60 ml) was added and the red gum formed during heating gradually dissolved and a colourless solid began to precipitate. This was filtered and washed with ethyl acetate (30 ml) and hexane (100 ml) and dried in vacuo to yield the title compound as the endo isomer (4.33 g, 13%), m.p. 194-5°

b. endo-(±)-cis-8-(1-adamantylmethylaminocarbonyl)-2-oxo-5,6-benzobicyclo[2.2.2]octane-7-carboxylic acid

This was prepared essentially as described in example 1 step b. but using the oxo anhydride prepared in step a. above instead of the exo anhydride described in example 1 step a. Yield step b. 75%). The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 61.86; H, 7.74; N, 4.53. $C_{32}H_{46}N_2O_9$. $1.00H_2O$ requires C, 61.92; H, 7.79; N, 4.51%

Example 14 Preparation of endo and exo cis-(±)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzo-5,6-(2,3-naphtho)bicyclo[2.2.2]octane-7-carboxylic acid

a. endo and exo 2,3-benzo-5,6-(2,3-naphtho)-bicyclo[2.2.2]octane-7,8-dicarboxylic anhydride

2,3-benzanthracene (1.0 g, 4.4 mmol) and maleic anhydride (0.43 g, 4.4 mmol) were dissolved in toluene (20 ml) and heated at reflux for 2.5 h under an atmosphere of argon. The reaction was cooled to room temperature and crystals precipitated which were filtered and washed with toluene and hexane before being dried in vacuo. The anhydride was isolated as an inseparable mixture of endo and exo isomers (1.13 g, 79%).

b. endo and exo cis-(±)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzo-5,6-(2,3-naphtho)bicyclo[2.2.2]octane-7-carboxylic acid

The reaction was performed essentially as in Example 1 using the anhyride produced in step a. above as substrate instead of the exo isomer produced in Example 1 step a. The compound was characterised and tested as the N-methyl glucamine salt. Found: C, 66.28; H, 7.39; N, 3.92. $C_{40}H_{50}N_2O_8.2H_2O$ requires C, 66.43; H, 7.53; N, 3.87%.

Example 15 Preparation of endo-cis-7-(2-R-(3-indolyl)-1-carboxy-ethylaminocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene (Diastereomer 1)

a. endo-cis-7-(2-R-(3-indolyl)-1-benzyloxycarbonyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene and separation of diastereomers

The mixture of diastereomers was prepared essentially as in example 8 but using the trifluoroacetate salt of D-tryptophan benzyl ester instead of L-alanine methyl ester hydrochloride. Column chromatography (silica 20% ethyl acetate and 80% dichloromethane) led to the separate diastereomers the high rF material diastereomer 1 and the low rF material diastereomer 2.

b. endo-cis-7-(2-R-(3-indolyl)-1-carboxy-ethylamino-carbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene (Diastereomer 1)

The reaction was performed essentially as described in example 9 step b. but using diastereomer 1 described in step a. above as substrate instead of the compound of example 9 step a. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 59.92; H, 7.55; N, 6.19. $C_{43}H_{56}N_4O_9$. 5.5 H_2O requires C, 59.23; H, 7.74; N, 6.43%

Example 16 Preparation of endo-cis-7-(2-R-(3-indolyl)-1-carboxy-ethylaminocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene (Diastereomer 2)

The reaction was performed essentially as described in example 9 step b. but using diastereomer 2 described in example 15 step a. as substrate instead of the compound of

example 9 step a. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 63.61; H, 7.62; N, 6.72. $C_{43}H_{56}N_4O_9$. 2.25 H_2O requires C, 63.50; H, 7.50; N, 6.89%

Example 17 Preparation of exo-cis-7-(2-R-(3-indolyl)-1-carboxy-ethylaminocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene (Diastereomer 1)

The compound was prepared as in example 15 but using the compound of example 1 as substrate in step a. rather than the compound of example 2. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 63.58; H, 7.55; N, 6.76. $C_{43}H_{56}N_4O_9$. 2.25 H_2O requires C, 63.50; H, 7.50; N, 6.89%

Example 18 Preparation of exo-cis-7-(2-R-(3-indolyl)-1-carboxy-ethylaminocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene (Diastereomer 2)

The reaction was performed essentially as described in example 16 but using diastereomer 2 described in example 17 step a. as substrate instead of diastereomer 2 of example 15 step a. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 63.58; H, 7.55; N, 6.76. $C_{43}H_{56}N_4O_9$. 2.25 H_2O requires C, 63.50; H, 7.50; N, 6.89%

Example 19 Preparation of exo-cis-7-(1-S-Methoxycarbonyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-dimethyl-5,6-benzobicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

The compound was prepared essentially as in example 7 but

using the product of example 11 as substrate instead of the product of example 1 found: C, 73.65; H, 8.06; N, 5.57. $C_{31}H_{40}N_2O_4$ requires C, 73.78; H, 7.99; N, 5.55%

Example 20 Preparation of endo and exo cis-7-(2-R-carboxy-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzo-5,6-(2,3-naphtho)bicyclo[2.2.2]octane (mixture of diastereomers)

The compound was prepared essentially as in example 9 but using the product of example 14 as substrate instead of the product of example 1 in step a. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 65.38; H, 7.47; N, 5.13. $C_{45}H_{57}N_3O_9$. 2.34 H_2O requires C, 65.43; H, 7.53; N, 5.09%

Example 21 Preparation of endo and exo cis-7-(2-S-methoxy-carbonylpyrrolidinocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-2,3-benzo-5,6-(2,3-naphtho)bicyclo-[2.2.2]octane (mixture of diastereomers)

The compound was prepared essentially as in example 20 but using L-proline methyl ester as substrate instead of D-Proline benzyl ester in the coupling step. Obviously no hydrogenation was necessary. Found: C, 73.53; H, 6.93; N, 4.81. $C_{39}H_{42}N_2O_4$. 1.72 H_2O requires C, 73.91; H, 7.23; N, 4.42%

Example 22 Preparation of endo-cis-7-(1-S-Methoxycarbonyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.2]octane (mixture of diastereomers)

The compound of example 8 (60 mg, 0.126 mmol) was dissolved in dry THF (10 ml) and Adams catalyst (20 mg) was added. The mixture was stirred under an atmosphere of hydrogen for 18 h and then filtered through a plug of celite and evaporated

to leave a colourless solid (38 mg, 63%) found: C, 72.16; H, 8.05; N, 5.79. $C_{29}H_{38}N_2O_4$. 0.23 H_2O requires C, 72.15; H, 8.03; N, 5.80%

Example 23 Preparation of exo-cis-7-(1-S-Methoxycarbonyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.2]octane (mixture of diastereomers)

The reaction was performed essentially as in example 22 but using the product of example 7 as substrate rather than the product of example 8 found: C, 72.76; H, 8.21; N, 5.79. $C_{29}H_{38}N_2O_4$ requires C, 72.77; H, 8.00; N, 5.85%

Example 24 Preparation of endo-cis-2-(1-S-Methoxycarbonyl-ethylaminocarbonyl)-3-(1-adamantylmethylaminocarbonyl)-bicyclo[2.2.2]oct-5-ene (mixture of diastereomers)

a. endo-cis-(±)-3-(1-adamantylmethylaminocarbonyl)-bicyclo[2.2.2]oct-5-ene-3-carboxylic acid

endo-Bicyclo[2.2.2]oct-5-ene-2,3-dicarboxylic anhydride (1.0 g, 5.6 mmol) was dissolved in THF (30 ml) and 1-adamantylmethylamine (0.93 g, 5.6 mmol) was added. The mixture was heated at reflux briefly and then cooled to room temperature whereupon it was stirred for a further hour. The reaction mixture was filtered, washed with THF and ether and then dried to give the target compound (1.86 g, 97%)

b. endo-cis-2-(1-S-Methoxycarbonyl-ethylaminocarbonyl)-3-(1-adamantylmethylaminocarbonyl)-bicyclo[2.2.2]oct-5-ene (mixture of diastereomers)

The reaction was performed as in example 7 but using the product from step a. above as substrate instead of the product of example 1

Example 25 Preparation of cis-(±)-2-(1-S-Methoxycarbonyl-ethylaminocarbonyl)-3-(1-adamantylmethylaminocarbonyl)-bicyclo[2.2.2]octane

The reaction was performed essentially as in example 22 but using the product of example 24 as substrate rather than the product of example 8. Found: C, 58.90; H, 7.88; N, 5.21. $C_{25}H_{38}N_2O_4$. 1.2 mol DCM requires C, 59.10; H, 7.88; N, 5.21%

Example 26 Preparation of endo-cis-7-(2-S-carboxy-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzo-bicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

The compound was prepared essentially as in example 10 but using L-proline benzyl ester as substrate rather than D-proline benzyl ester in step a. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 60.00; H, 8.04; N, 5.03. $C_{37}H_{53}N_3O_9$. 1.0 mol dioxan. 2.7 mol H_2O requires C, 60.01; H, 8.16; N, 5.12%

Example 27 Preparation of exo-cis-7-(2-S-carboxy-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzo-bicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

The compound was prepared essentially as in example 9 but using L-proline benzyl ester as substrate rather than D-proline benzyl ester in step a. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 60.41; H, 7.99; N, 5.34. $C_{37}H_{53}N_3O_9$. 3.0 mol H_2O requires C, 60.17; H, 8.06; N, 5.69%

Example 28 Preparation of endo-cis-7-(2-R-carboxy-4-R-hydroxy-pyrrolidinocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-5,6-benzo-bicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

The compound was prepared essentially as in example 10 but using cis-D-hydroxy-proline benzyl ester as substrate rather than D-proline benzyl ester in step a. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 60.54; H, 7.65; N, 4.82. $C_{37}H_{53}N_3O_{10}$. 1.3 mol dioxan. 1.1 mol H_2O requires C, 60.76; H, 7.93; N, 5.04%

Example 29 Preparation of exo-cis-7-(2-R-carboxy-4-R-hydroxy-pyrrolidinocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-5,6-benzo-bicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

The compound was prepared essentially as in example 9 but using cis-D-hydroxyproline benzyl ester as substrate rather than D-proline benzyl ester in step a. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 58.32; H, 7.67; N, 5.18. $C_{37}H_{53}N_3O_{10}$. 3.6 mol H_2O requires C, 58.11; H, 7.94; N, 5.49%

Example 30 Preparation of endo-cis-7-(2-S-methoxycarbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzo-bicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

The compound of example 26 (100 mg, 0.205 mmol) was dissolved in methanol (20 ml) and trested with an ethereal solution of diazomethane. Acetic acid was added to decompose extra diazomethane and the solution evaporated to leave the title compound as a colourless solid. Found: C, 71.61; H, 8.34; N, 5.13. $C_{31}H_{38}N_2O_4$. 1.3 mol MeOH requires C, 71.27; H, 8.00; N, 5.15%

Example 31 Preparation of exo-cis-7-(2-S-methoxycarbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzo-bicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

The compound was prepared essentially as in example 30 but using the compound of example 27 as substrate rather than the compound of example 26. Found: C, 72.30; H, 8.15; N, 5.03. $C_{31}H_{38}N_2O_4$. 0.9 mol MeOH requires C, 72.09; H, 7.89; N, 5.27%

Example 32 Preparation of exo-cis-7-(2-R-methoxycarbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzo-bicyclo[2.2.2]oct-2-ene (mixture of diastereomers)

The compound was prepared essentially as in example 30 but using the compound of example 9 as substrate rather than the compound of example 26. Found: C, 66.04; H, 7.15; N, 4.81. $C_{31}H_{38}N_2O_4$. 0.6 mol MeOH. 0.8 mol DCM requires C, 65.98; H, 7.18; N, 4.75%

Example 33 Preparation of cis-(±)-2-(1-R-carboxy-pyrrolidinocarbonyl)-3-(1-adamantylmethylaminocarbonyl)-bicyclo[2.2.2]oct-5-ene

The reaction was performed as in example 9 but using the product from example 24 step a. in step a. as substrate instead of the product of example 1. The compound was characterised and tested as the N-methyl-D-glucamine salt. Found: C, 54.29; H, 8.68; N, 4.86. $C_{33}H_{53}N_3O_9$. 1.3 mol Dioxan. 5.2 mol H_2O requires C, 54.36; H, 8.81; N, 4.98%

Example 34 Preparation of endo-cis-7-(2-R-carboxy-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2-oxo-5,6-benzobicyclo[2.2.2]octane (mixture of diastereomers 1)

The compound was prepared essentially as in example 9 but using the product of example 13 step a. as substrate instead of the product of example 1 in step a. The product of step

a. was separated into two fractions by column chromatography (silica, 25% ethyl acetate and 75% dichloromethane). The less polar material was converted into the title compound.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 59.96; H, 7.80; N, 5.59. $C_{37}H_{53}N_3O_{10}.2.3\ H_2O$ requires C, 59.95; H, 7.83; N, 5.67%.

Example 35 Preparation of endo-cis-7-(2-R-carboxy-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2-oxo-5,6-benzobicyclo[2.2.2]octane (mixture of diastereomers 2)

The compound was prepared essentially as in example 34 but using the more polar material isolated from the column chromatography in the final step.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 49.05; H, 6.69; N, 4.29. $C_{37}H_{53}N_3O_{10}.3.1\ H_2O.2.6\ SiO_2$ requires C, 48.73; H, 6.54; N, 4.61%.

Example 36 Preparation of (±)-endo-cis-8-(1-adamantylmethyl-aminocarbonyl)-2-(±)-benzyl-5,6-benzobicyclo[2.2.2]octane-7-carboxylic acid (mixture of regioisomers).

a. (±)- endo-dimethyl-2-oxo-5,6-benzobicyclo[2.2.2]octane-7,8-dicarboxylate

The compound of example 9 step a. (10.7g, 4.4 mmole) was dissolved in methanol (200 ml) and concentrated sulphuric acid (0.5 ml) was added. The solution was heated at reflux for 5h and then cooled and evaporated to a low volume (approx. 20 ml). The oil was taken up in diethyl ether and washed with 10% sodium carbonate solution (2 x 20 ml) and then dried, filtered and evaporated. The residual oil was

taken up in acetone (100 ml) and 4-toluenesulphonic acid (0.8 g) was added. The solution was heated at reflux for 1h, and then evaporated. The oil was triturated with diethyl ether to leave the title compound as a white solid (5.8 g).

b. (±)-endo-dimethyl-2-hydroxy-2-benzyl-5,6-benzobicyclo-[2.2.2]octane-7,8-dicarboxylate

Powdered samarium (6.0 g, 40 mmol) was placed in a flask under dry nitrogen. A solution of 1,2-diiodoethane (5.64g, 20 mmol) in dry THF (400 ml) was added dropwise over 1h. The reaction mixture was stirred for a further hour in which time a deep blue solution was formed. The product of step a. (5.76 g, 40 mmol) was added in dry THF (20 ml) followed by benzyl bromide (3.82 g, 22 mmol). The mixture was stirred at room temperature for 2h. The blue solution was decanted from the samarium metal and diluted with 1M hydrochloric acid (400 ml). This solution was extracted with diethyl ether (2 x 200 ml). The combined organic layer was washed with water, 10% sodium thiosulphate solution and brine and dried. After fitraton and evaporation a white foam was left (7.56 g) which was the title compound.

c. (±)-endo-dimethyl-2-benzyl-5,6-benzobicyclo[2.2.2]oct-2-ene-7,8-dicarboxylate

The product of step b. (700 mg, 1.9 mmol) was dissolved in benzene(10 ml)and 4-toluenesulphonic acid (80 mg, 0.42 mmol) was added. The solution was stirred and refluxed for 2.5h in the presence of 4A molecular sieves. The mixture was diluted with ethyl acetate (20 ml) and washed with 10% sodium hydrogencarbonate solution (20 ml) and brine (20 ml). The solution was dried, filtered and evaporated to leave a material that was purified by column chromatography (silica ethyl acetate and hexane 2:1). This left the title compound (250 mg) as a cis/trans mixture of double bonds.

d. (±)-endo-dimethyl-2-benzyl-5,6-benzobicyclo[2.2.2]octane-

7,8-dicarboxylate

The product of step c. (200 mg, 0.6 mmol) was dissolved in methanol (10 ml) and 5% platinum on carbon catalyst (30 mg) was added. Hydrogen was introduced to the flask. The catalyst was removed by fitration through celite and the filtrate was evaporated to leave the title compound as a colourless oil (200 mg).

e. (±)-endo-2-benzyl-5,6-benzobicyclo[2.2.2]octane-7,8-dicarboxylic acid

The product of step d. (200 mg, 0.6 mmol) was dissolved in ethanol (5 ml) and sodium hydroxide (100 mg, 2.5 mmol) in water (1 ml) was added. The mixture was heated at reflux for 2h. The solution was cooled and evaporated to low volume and acidified with 2M hydrochloric acid solution. The aqueous layer was then extracted with ethyl acetate (10 ml) and the organic layer was washed with brine. The ethyl acetate layer was dried, filtered and evaporated to leave the title compound (144 mg).

f. (±)-endo-2-benzyl-5,6-benzobicyclo[2.2.2]octane-7,8-dicarboxylic acid anhydride.

The product of step e. (2.15 g, 6.4 mmol) and acetic anhydride (5 ml) were heated at 120° for 1h. The excess acetic anhydride was removed by distillation at 70° and 0.1 mm Hg to leave the title compound 2.0 g

g. (±)-endo-cis-8-(1-adamantylmethylaminocarbonyl)-2-(±)-benzyl-5,6 -benzobicyclo[2.2.2]octane-7-carboxylic acid.

The product of step f. (2.0 g, 6 mmol) was dissolved in dry THF (20 ml) and triethylamine (1.0 ml) was added. This was followed by 1-adamantylmethylamine (1.16 g, 0.6 mmol) and the reaction mixture stirred at room temperature for 1h. The reaction mixture was diluted with ethyl acetate (30 ml) and

extracted with 1M hydrochloric acid. The organic phase was extracted with brine, dried, filtered and evaporated and purified by column chromatography (silica 95% ethyl acetate and 5% acetone). This left the title compound (256 mg) as a white solid.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 69.21; H, 8.02; N, 4.13. $C_{39}H_{54}N_2O_8$. requires C, 69.00; H, 8.11; N, 4.10%.

Example 37 Preparation of cis-7-(2R-carboxymethylaminocarbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzo-5,6-(2,3-naphtho)bicyclo[2.2.2]octane (mixture of diastereomers 1)

a. cis-7-(2R-benzyloxycarbonylmethylaminocarbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzo-5,6-(2,3-naphtho)bicyclo[2.2.2]octane

The product of example 14 (164 mg, 0.33 mmol) was dissolved in dichloromethane (40 ml) and D-prolyl-glycine benzyl ester trifluoroacetate salt (121 mg, 0.33 mmol), Hunigs base (0.18 ml, 1 mmol) and PyBOP (174 mg, 0.33 mmol) were added. The solution was stirred for 84h at room temperature and then washed sequentially with 2M hydrochloric acid (20 ml), saturated sodium hydrogencarbonate solution (20 ml) and saturated brine (20 ml). The solution was dried, filtered and evaporated and then purified by column chromatography (silica and ethyl acetate) to give two fractions. The less polar material (R_f 0.7) was the compound of this example (71 mg) (product a). The more polar material (R_f 0.3) was designated product b (68 mg).

b. cis-7-(2R-carboxymethylaminocarbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzo-5,6-(2,3-naphtho)bicyclo[2.2.2]octane (mixture of diastereomers 1)

This was prepared as in example 9 step b. but using the compound of step a. above instead of the product of example 9 step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 48.80; H, 6.18; N, 4.81. $C_{47}H_{60}N_4O_{10}.3.9\ H_2O.\ 4.2$ Silica requires C, 48.51; H, 5.87; N, 4.81%.

Example 38 Preparation of cis-7-(2R-carboxymethylaminocarbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzo-5,6-(2,3-naphtho)bicyclo[2.2.2]octane (mixture of diastereomers 2)

This was prepared as in example 9 step b. but using the compound of example 37 step a. product b instead of the product of example 9 step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 52.42; H, 6.87; N, 5.07. $C_{47}H_{60}N_4O_{10}.6.2\ H_2O.\ 2.1$ Silica requires C, 52.32; H, 6.76; N, 5.19%.

Example 39 Preparation of (±)-endo and exo-cis-7-(1-adamantylmethylaminocarbonyl)-2-diphenylmethylene bicyclo-[2.2.1]hept-4-ene-6-carboxylic acid.

a. endo and exo cis-2-diphenylmethylene bicyclo[2.2.1]hept-4-ene-6,7-dicarboxylic acid anhydride.

Diphenylfulvene (1.15g, 5 mmol), maleic anhydride (0.6 g, 6 mmol) and hydroquinone (10 mg) were dissolved in toluene (10 ml) and stirred at reflux overnight. After cooling the mixture was evaporated and the residue was taken up in a minimum volume of hot toluene. and an equal volume of hexane was added. After cooling pale yellow crystals were formed

which were isolated by filtration. These were washed with hexane and dried in vacuo to yield the title compound (1.45 g).

b. (±)-endo and exo-cis-7-(1-adamantylmethylaminocarbonyl)-2-diphenylmethylene bicyclo[2.2.1]hept-4-ene-6-carboxylic acid

The product was prepared essentially as in example 36 step g. except that the product of step a. above was used as substrate instead of the product of example 36 step f. The final compound was a 2:1 mixture of endo and exo products but absolute structure could not be assigned.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 70.00; H, 7.90; N, 4.21. $C_{40}H_{52}N_2O_8$. requires C, 69.74; H, 7.61; N, 4.21%

Example 40 Preparation of cis-exo-7-(2R-(1S-carboxyethyl-aminocarbonyl)-pyrrolidinocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

a. cis-exo-7-(2R-(1S-benzyloxycarbonylethylaminocarbonyl)-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.2]oct-2-ene

This was prepared essentially as in example 7 but using D-prolyl-L-alanine benzyl ester as substrate instead of L-alanine methyl ester hydrochloride.

b. cis-exo-7-(2R-(1S-carboxyethylaminocarbonyl)-pyrrolidino-carbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzo-bicyclo[2.2.2]octane

This was prepared essentially as in example 22 except that the substrate from step a. above was used instead of the compound of example 8.

The compound was further characterised and tested as the N-methyl-D-glucamine salt.

Example 41 Preparation of cis-exo-7-(2R-(1R-carboxyethyl-aminocarbonyl)-pyrrolidinocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 40 except that D-prolyl-D-alanine benzyl ester was used as substrate instead of D-prolyl-L-alanine benzyl ester in step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt.

Example 42 Preparation of cis-exo-7-(2R-carboxymethylamino-carbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylamino-carbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 40 except that D-prolyl-glycine benzyl ester was used as substrate instead of D-prolyl-L-alanine benzyl ester in step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt.

Example 43 Preparation of cis-exo-7-(2S-(1S-carboxyethyl-aminocarbonyl)-pyrrolidinocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 40 except that L-prolyl-L-alanine benzyl ester was used as substrate instead of D-prolyl-L-alanine benzyl ester in step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt.

Example 44 Preparation of cis-exo-7-(2S-(1R-carboxyethyl-aminocarbonyl)-pyrrolidinocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 40 except that L-prolyl-D-alanine benzyl ester was used as substrate instead of D-prolyl-L-alanine benzyl ester in step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt.

Example 45 Preparation of cis-exo-7-(2R-carboxymethylamino-carbonylpyrrolidinocarbonyl)-8-(1-adamantylmethylamino-carbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 40 except that L-prolyl-glycine benzyl ester was used as substrate instead of D-prolyl-L-alanine benzyl ester in step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt.

Example 46 Preparation of cis-endo-7-(2R-carboxymethylamino-carbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylamino-carbonyl)-2,3-benzobicyclo[2.2.2]octane

a. cis-endo-7-(2R-benzyloxycarbonylmethylaminocarbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.2]oct-2-ene

This was prepared essentially as in example 8 but using D-prolyl-glycine benzyl ester as substrate instead of L-alanine methyl ester hydrochloride.

b. cis-endo-7-(2R-(1S-carboxyethylaminocarbonyl)-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.2]octane.

This was prepared essentially as in example 22 except that the substrate from step a. above was used instead of the compound of example 8.

The compound was further characterised and tested as the N-methyl-D-glucamine salt.

Example 47 Preparation of cis-endo-7-(2R-(1R-carboxyethyl-aminocarbonyl)-pyrrolidinocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 46 except that D-prolyl-D-alanine benzyl ester was used as substrate instead of D-prolyl-glycine benzyl ester in step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt.

Example 48 Preparation of cis-endo-7-(2R-(1S-carboxy-ethylaminocarbonyl)-pyrrolidinocarbonyl)-8-(1-adamantyl-methylaminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 46 except that D-prolyl-L-alanine benzyl ester was used as substrate instead of D-prolyl-glycine benzyl ester in step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt.

Example 49 Preparation of cis-endo-7-(2S-carboxymethylaminocarbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 46 except that L-prolylglycine benzyl ester was used as substrate instead of D-prolyl-glycine benzyl ester in step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt Found: C, 56.76; H, 8.15; N, 7.05. $C_{39}H_{58}N_4O_{10}.4.4\ H_2O$ requires C, 57.00; H, 8.19; N, 6.82%

Example 50 Preparation of cis-endo-7-(2S-(1R-carboxyethyl-aminocarbonyl)-pyrrolidinocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 46 except that L-prolyl-D-alanine benzyl ester was used as substrate instead of D-prolyl-glycine benzyl ester in step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 58.51; H, 8.25; N, 4.61. $C_{40}H_{60}N_4O_{10}.4.9\ H_2O$. 0.6 silica requires C, 58.45; H, 8.16; N, 4.57%

Example 51 Preparation of cis-endo-7-(2S-(1S-carboxyethyl-aminocarbonyl)-pyrrolidinocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 46

except that L-prolyl-L-alanine benzyl ester was used as substrate instead of D-prolyl-glycine benzyl ester in step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 52.22; H, 7.64; N, 5.96. $C_{40}H_{60}N_4O_{10}.4.9\ H_2O$. 1.2 dichloromethane requires C, 52.25; H, 7.68; N, 5.92%

Example 52 Preparation of cis-endo-7-(2S-(1R-carboxyethyl-aminocarbonylmethyl)-pyrrolidinocarbonyl)-8-(1-adamantyl-methylaminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 46 except that L-pyrrolidinomethylcarbonyl-D-alanine benzyl ester was used as substrate instead of D-prolyl-glycine benzyl ester in step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt.

Example 53 Preparation of cis-(±)-exo-6-(2R-carboxy-pyrrolidinocarbonyl)-7-(1-adamantylmethylaminocarbonyl)-2,2-diphenylbicyclo[2.2.1]hept-4-ene

a. exo-2,2-diphenylbicyclo[2.2.1]hept-4-ene-6,7-dicarboxylic acid anhydride.

1,1-diphenylcyclopentadiene (prepared as in J.A.C.S., 1990, 112, 6695)(900 mg, 3.9 mmol) and maleic anhydride (425 mg, 4.3 mmol) were dissolved in toluene (10 ml) and stirred and heated at 85° overnight. Hexane (20 ml) was added to the warm solution and upon cooling a pale yellow crystalline solid was formed. This was isolated by filtration, washed with a small quantity of hexane and dried to yield the title compound (470 mg).

b. (±)-exo-cis-7-(1-adamantylmethylaminocarbonyl)-2,2-diphenylbicyclo[2.2.1]hept-4-ene-6-carboxylic acid.

This compound was prepared essentially as in example 36 step g. except that the product of step a. of this example was used as substrate instead of the compound of example 36 step f.

c. cis-(±)-exo-6-(2R-carboxy-pyrrolidinocarbonyl)-7-(1-adamantylmethylaminocarbonyl)-2,2-diphenylbicyclo[2.2.1]hept-4-ene

This compound was prepared essentially as in example 9 except that the product of step b. was used as substrate instead of the compound of example 1 and the t-butyl ester of D-proline was used instead of the benzyl ester. Deprotection was carried out by use of trifluoroacetic acid in dichloromethane.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 65.11; H, 7.67; N, 5.40. $C_{44}H_{59}N_3O_9.2H_2O$ requires C, 65.25; H, 7.84; N, 5.19%

Example 54 Preparation of 1-methoxycarbonyl-endo-cis-(±)-7-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo-[2.2.1]hept-6-carboxylic acid

a. 1-methoxycarbonyl-endo-cis-(±)-2,3-benzobicyclo-[2.2.1]hept-6,7-dicarboxylic acid anhydride.

Methyl 1-indenecarboxylate (12.5 g, 71.5 mmol) and maleic anhydride (14.02 g, 143 mmol) were heated together in xylene (90 ml) at reflux for 24h. The solution was allowed to cool to room temperature and evaporated to a volume of about 20 ml. Diethyl ether (20 ml) was added and the solution was left to stand for 1h. The crystalline precipitate was filtered, washed with diethyl ether and dried to leave the

title compound (11.36 g, 58%).

b. 1-methoxycarbonyl-endo-cis-(±)-7-(1-adamantylmethyl-aminocarbonyl)-2,3-benzobicyclo[2.2.1]hept-6-carboxylic acid

This compound was prepared essentially as in example 36 step g. except that the product of step a. of this example was used as substrate instead of the compound of example 36 step f.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 61.84; H, 8.11; N, 4.07. $C_{33}H_{48}N_2O_{10}$ 0.64 H_2O requires C, 61.52; H, 7.71; N, 4.35%

Example 55 Preparation of (±)-1-methoxycarbonyl-endo-cis-6-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenylethylamino-carbonyl)-7-(1-adamantylmethylaminocarbonyl)-2,3-benzo-bicyclo[2.2.1]heptane

This compound was prepared essentially as in example 9 except that the product of example 54 was used as substrate instead of the compound of example 1 and 1S-(3,5-dibenzyloxycarbonylphenylaminocarbonyl)-2-phenyl-ethylamine was used instead of the benzyl ester of D-proline in step a.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt. Found: C, 57.55; H, 7.44; N, 4.45. $C_{57}H_{79}N_5O_{19}$ 1.6 H_2O. 4.1 dioxan requires C, 57.68; H, 7.58; N, 4.58%

Example 56 Preparation of (±)-1-methoxycarbonyl-endo-cis-6-(2R-carboxypyrrolidinocarbonyl)-7-(1-adamantylmethylamino-carbonyl)-2,3-benzobicyclo[2.2.1]heptane

This compound was prepared essentially as in example 9 except that the product of example 54 was used as substrate instead of the compound of example 1.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 53.14; H, 7.58; N, 3.55. $C_{38}H_{55}N_3O_{11}$ 2.2 dichloromethane and 4.1 dioxan requires C, 53.21; H, 7.29; N, 3.27%

Example 57 Preparation of endo-cis-(±)-7-(1-adamantylmethyl-aminocarbonyl)-2,3-benzobicyclo[2.2.1]hept-6-carboxylic acid

a. endo-cis-(±)-2,3-benzobicyclo[2.2.1]hept-6,7-dicarboxylic acid anhydride.

Indene (40.4 g, 348 mmol), maleic anhydride (24.12 g, 246 mmol) and hydroquinone (1.5 g) were heated together in tetralin (35 ml) at reflux for 4.5h under an atmosphere of argon. The solution was allowed to cool to 120° and poured cautiously into ethyl acetate (100 ml) and the resulting solution poured into toluene (300 ml) with stirring. The ethyl acetate was removed by evaporation and toluene (100 ml) was added. The solution was heated and the polymer was removed by filtraton. The solution was then cooled to -10° and the crystalline product was isolated by filtration. This left the title compound (8.24 g).

b. endo-cis-(±)-7-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.1]hept-6-carboxylic acid

This compound was prepared essentially as in example 36 step g. except that the product of step a. of this example was used as substrate instead of the compound of example 36 step f.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 62.00; H, 8.43; N, 4.10.

$C_{31}H_{46}N_2O_8$ 2.0 dioxan requires C, 62.37; H, 8.32; N, 3.73%

Example 58 Preparation of (±)-endo-cis-6-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-7-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo-[2.2.1]heptane

This compound was prepared essentially as in example 55 except that the product of example 57 was used as substrate instead of the compound of example 54 in step a.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt.

Example 59 Preparation of (±)-endo-cis-6-(2R-carboxy-pyrrolidinocarbonyl)-7-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.1]heptane

This compound was prepared essentially as in example 9 except that the product of example 57 was used as substrate instead of the compound of example 1.

The compound was further characterised and tested as the N-methyl-D-glucamine salt. Found: C, 53.14; H, 7.58; N, 3.55. $C_{38}H_{55}N_3O_{11}$ 2.2 dichloromethane and 4.1 dioxan requires C, 53.21; H, 7.29; N, 3.27%

Example 60 Preparation of exo-cis-7-(1S-(3,5-dicarboxy-phenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene

This compound was prepared essentially as in example 9 except that 1S-(3,5-dibenzyloxycarbonylphenylaminocarbonyl)-

2-phenyl-ethylamine was used instead of the benzyl ester of D-proline in step a.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt. Found: C, 57.04; H, 7.76; N, 5.97. $C_{56}H_{77}N_5O_{17}$ 5.0 H_2O requires C, 56.85; H, 7.42; N, 5.92%

Example 61 Preparation of exo-cis-7-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 40 except that 1S-(3,5-dibenzyloxycarbonylphenylaminocarbonyl)-2-phenyl-ethylamine was used as substrate instead of D-prolyl-L-alanine benzyl ester in step a.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt. Found: C, 58.90; H, 7.81; N, 6.22. $C_{56}H_{79}N_5O_{17}$ 2.8 H_2O 0.4 dioxan requires C, 58.63; H, 7.50; N, 5.94%

Example 62 Preparation of endo-cis-7-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene

This compound was prepared essentially as in example 10 except that 1S-(3,5-dibenzyloxycarbonylphenylaminocarbonyl)-2-phenyl-ethylamine was used instead of the benzyl ester of D-proline in step a.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt.

Example 63 Preparation of endo-cis-7-(1S-(3,5-dicarboxy-

phenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 46 except that 1S-(3,5-dibenzyloxycarbonylphenylaminocarbonyl)-2-phenyl-ethylamine was used as substrate instead of D-prolyl-glycine benzyl ester in step a.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt. Found: C, 58.90; H, 7.81; N, 6.22. $C_{56}H_{79}N_5O_{17}$ 2.8 H_2O 0.4 dioxan requires C, 58.63; H, 7.50; N, 5.94%

Example 64 Preparation of exo-cis-7-(1R-(3,5-dicarboxy-phenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene

This compound was prepared essentially as in example 9 except that 1R-(3,5-dibenzyloxycarbonylphenylaminocarbonyl)-2-phenyl-ethylamine was used instead of the benzyl ester of D-proline in step a.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt.

Example 65 Preparation of endo-cis-7-(1R-(3,5-dicarboxy-phenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene

This compound was prepared essentially as in example 10 except that 1R-(3,5-dibenzyloxycarbonylphenylaminocarbonyl)-2-phenyl-ethylamine was used instead of the benzyl ester of D-proline in step a.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt.

Example 66 Preparation of (±)-endo-cis-6-(1R-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-7-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.1]heptane

This compound was prepared essentially as in example 55 except that the product of example 57 was used as substrate instead of the compound of example 54 in step a, and the 1R isomer of 1-(3,5-dibenzyloxycarbonylphenylaminocarbonyl)-2-phenyl-ethylamine was used instead of the 1S.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt.

Example 67 Preparation of exo-cis-7-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-naphthylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene

a. (±)-exo-cis-8-(1-naphthylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene-7-carboxylic acid

The compound was prepared essentially as in example 1 step b. but using 1-naphthylmethylamine as substrate instead of 1-adamantylmethylamine.

b. exo-cis-7-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-naphthylmethyl-aminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene

The compound was prepared essentially as in example 60 except that the compound of example 67 step a. above was used as substrate in step a. instead of the compound of example 1.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt.

Example 68 Preparation of exo-cis-7-(1R-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-naphthylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene

The compound was prepared essentially as in example 64 except that the compound of example 67 step a. was used as substrate in step a. instead of the compound of example 1.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt.

Example 69 Preparation of endo-cis-7-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-naphthylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene

a. (±)-8-endo-cis-(1-naphthylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene-7-carboxylic acid

The compound was prepared essentially as in example 2 step b. but using 1-naphthylmethylamine as substrate instead of 1-adamantylmethylamine.

b. endo-cis-7-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-naphthylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene

The compound was prepared essentially as in example 60 except that the compound of example 69 step a. above was used as substrate in step a. instead of the compound of example 1.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt.

Example 70 Preparation of endo-cis-7-(1R-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-naphthylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene

The compound was prepared essentially as in example 64 except that the compound of example 69 step a. was used as substrate in step a. instead of the compound of example 1.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt.

Example 71 Preparation of (±)-1-methoxycarbonyl-endo-cis-6-(1R-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-7-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.1]heptane

The compound was prepared essentially as in example 9 except that the product of example 54 was used as substrate instead of the compound of example 1 and 1R-(3,5-dibenzyloxycarbonylphenylaminocarbonyl)-2-phenyl-ethylamine was used instead of the benzyl ester of D-proline in step a.

The compound was further characterised and tested as the di N-methyl-D-glucamine salt.

Example 72 Preparation of cis-exo-7-(2S-(1R-carboxyethylaminocarbonylmethyl)-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

The compound was prepared essentially as in example 40 except that L-pyrrolidinomethylcarbonyl-D-alanine benzyl ester was used as substrate instead of D-prolyl-glycine benzyl ester in step a.

The compound was further characterised and tested as the N-methyl-D-glucamine salt.

The following ^1H NMR data were obtained for the compounds described in the examples:

Ex.1a (exo isomer) (d^6-DMSO) δ 7.4-7.1 (4H, m), 6.7 (2H, dd), 4.5 (2H, m), 3.4 (2H, m).

Ex.1a (endo isomer) (d^6-DMSO) δ 7.2-7.1 (4H, m), 6.7 (2H, dd), 4.4 (2H, m), 3.4 (2H, m).

Ex.1b (d^6-DMSO) δ 10.5 (1H, br s), 7.6 (1H, t), 7.2 (2H, m), 7.0 (2H, m), 6.5 (1H, t), 6.3 (1H, t), 4.1 (1H, d), 4.0 (1H, d), 2.9-2.5 (4H, m), 1.9 (3H, s), 1.6 (6H, q), 1.4 (6H, s).

Ex.2 (d^6-DMSO) δ 11.2 (1H, br s), 7.4 (1H, t), 7.2 (1H, m), 6.9 (3H, m), 6.5 (2H, m), 4.0 (1H, d), 3.9 (1H, d), 3.1 (1H, d), 2.6 (2H, m), 2.4 (1H, m), 1.9 (3H, s), 1.6 (6H, q), 1.4 (6H, s).

Ex.3 (d^6-DMSO) δ 11.4 (1H, br s), 7.8 (1H, t), 7.2 (2H, m), 7.0 (2H, m), 6.5 (1H, t), 6.3 (1H, t), 4.1 (1H, d), 3.9 (1H, d), 2.8-2.6 (4H, m), 1.7-0.7 (11H, m).

Ex.4 (d^6-DMSO) δ 11.4 (1H, br s), 7.7 (1H, t), 7.2-6.9 (4H, m), 6.6 (2H, m), 4.0 (1H, d), 3.9 (1H, d), 3.1-2.6 (4H, m), 1.7-0.8 (11H, m).

Ex.5 (d^6-DMSO) δ 11.8 (1H, br s), 7.8 (1H, t), 7.2 (2H, m), 7.0 (2H, m), 6.5 (1H, t), 6.3 (1H, t), 4.1 (1H, d), 3.9 (1H, d), 3.0-2.6 (4H, m), 1.4-0.8 (15H, m).

Ex.6 (d^6-DMSO) δ 11.4 (1H, br s), 7.6 (1H, t), 7.2-6.9 (4H, m), 6.6 (2H, m), 4.0 (1H, d), 3.9 (1H, d), 3.0-2.7 (4H, m), 1.4-0.8 (15H, m).

Ex.7 ($CDCl_3$) δ 7.2-7.1 (4H, m), 6.9-6.0 (4H, m), 4.4, (1H, m), 4.2 (2H, m), 3.7 (3H, 2 x s), 3.2-2.5 (4H, m), 2.0 (3H, s), 1.6 (6H, q), 1.4 (6H, s), 1.3 (3H, 2 x d).

Ex.8 ($CDCl_3$) δ 7.4-7.1 (4H, m), 6.6 (2H, m), 6.0, 5.7, 5.3 and 5.0 (2H, 4 x m), 4.3, (1H, m), 4.2 (2H, m), 3.7 (3H, s), 3.2-3.0 (2H, m), 2.8-2.4 (2H, m), 2.0 (3H, s), 1.6 (6H, q), 1.4 (6H, s), 1.1 (3H, 2 x d).

Ex.9 (d^6-DMSO), 7.6 (1H, t), 7.2 (6H, m), 4.3-4.1 (1H, m), 3.5-3.0 (6H, m), 2.8-2.2 (4H, m), 2.0 (3H, s), 1.6 (6H, q), 1.4 (6H, s), 1.0 (2H, m).

Ex.10 (d^6-DMSO), 12.5 (1H, br s), 7.2 (6H, m), 5.9 (1H, t), 4.5-4.1 (1H, m), 3.8-2.9 (6H, m), 2.7-2.2 (4H, m), 2.0 (3H, s), 1.6 (6H, q), 1.4 (8H, m).

Ex.11b (d^6-DMSO) δ 11.5 (1H, br s), 7.6 (1H, t), 7.2 (2H, m), 7.0 (2H, m), 3.8 (1H, d), 3.6 (1H, d), 2.9 2H, m), 2.6 (2H, m), 1.9 (3H, s), 1.8 (3H, m), 1.6 (9H, m), 1.4 (6H, s).

Ex.12 (d^6-DMSO) δ 11.5 (1H, br s), 7.4 (1H, t), 7.2 (1H, m), 6.9 (3H, m), 3.7 (1H, d), 3.6 (1H, d), 3.1 (1H, dd), 2.7-2.4 (3H, m), 1.9 (3H, s), 1.8-1.5 (12H, m), 1.4 (6H, s).

Ex.13a (d^6-DMSO) δ 7.3 (4H, m), 3.94 (3H, m), 3.87 (1H, m), 2.6 (1H, m), 2.2(1H, d).

Ex.13b (d^6-DMSO) δ 11.3 (1H, br s), 7.7 (1H, m), 7.2 (4H, m), 3.6-3.2 (4H, m), 2.6 (2H, m), 2.1 (1H, m), 1.9 (3H, s), 1.6 (6H, q), 1.4 (6H, s).

Ex.14a (d^6-DMSO) δ 8.0-7.8 (10H,m), 5.0 (2H,s), 3.8 (2H,s).

Ex.14b (d^6-DMSO) δ 11.2 (1H,s), 7.9-6.9 (11H,m), 4.6 (1H,s), 4.5 (1H,s), 3.3-2.6 (4H,m), 1.9 (3H,s), 1.6 (6H,q), 1.4 (6H,s).

Ex.15b. ($CDCl_3$) δ 8.6 (1H, s), 7.6-7.0 (9H, m), 6.6 (2H, m), 6.1 (1H, br s), 5.6 (1H, br s), 4.6 (1H, m), 4.0-2.9 (6H, m), 2.6 (1H, m), 2.4 (1H, m), 1.9 (3H, s), 1.6 (6H, q), 1.3 (6H, d).

Ex.16 ($CDCl_3$) δ 8.6 (1H, s), 7.6-6.8 (12H, m), 5.4 (1H, br s), 4.6 (1H, m), 4.0-2.9 (6H, m), 2.6 (1H, m), 2.4 (1H, m), 1.9 (3H, s), 1.6 (6H, q), 1.3 (6H, d).

Ex.17 ($CDCl_3$) δ 8.4 (1H, s), 7.6-7.0 (12H, m), 6.1 (1H, br s), 4.8 (1H, m), 4.0 (1H, m), 3.4-2.9 (5H, m), 2.6 (1H, m), 2.4 (1H, m), 1.9 (3H, s), 1.6 (6H, q), 1.3 (6H, d).

Ex.18 ($CDCl_3$) δ 8.6 (1H, s), 7.6-6.9 (11H, m), 6.6 (1H, m), 6.4 (1H, br s), 4.8 (1H, m), 3.4-2.9 (6H, m), 2.6 (1H, m), 2.4 (1H, m), 1.9 (3H, s), 1.6 (6H, q), 1.3 (6H, d).

Ex.19 (d^6-DMSO) δ 8.6 (1H, s), 7.6-6.9(11H, m), 6.6 (1H, m), 6.4 (1H, br s), 4.8 (1H, m), 3.4-2.9 (6H, m), 2.6 (1H, m), 2.4 (1H, m), 1.9 (3H, s), 1.6 (6H, q), 1.3 (6H, d).

Ex.20 (d^6-DMSO) δ 13.0-12.0 (1H, br-s), 7.9-6.9 (11H, m), 4.6 (2H, m), 4.2 (1H, m) 3.5-3.1 (4H, m), 2.9-2.6 (2H, m), 1.9 (7H, m), 1.6 (6H, q), 1.3 (6H, s).

Ex.21 (d^6-DMSO) δ 7.9-6.8 (11H, m), 4.6 (2H, m), 4.2-4.0 (1H, m), 3.6 (3H, 2 x s), 3.5-3.1 (4H, m), 2.9-2.6 (2H, m), 1.9 (7H, m), 1.6 (6H, q), 1.3 (6H, s).

Ex.22 (d^6-DMSO) δ 8.0-6.1 (6H, m), 4.0 (1H, m), 3.6 (3H, s), 3.4-2.9 (8H, m), 2.6 (1H, m), 2.4 (1H, m), 1.9 (3H, m), 1.6 (6H, q), 1.3 (9H, m).

Ex.23 (d^6-DMSO) δ 7.9 (1H, d), 7.3 (1H, t), 7.1 (4H, s), 4.2 (1H, m), 3.6 (3H, s), 3.2-2.2 (10H, m), 1.9 (3H, m), 1.6 (6H, q), 1.3 (6H, s), 0.9 (3H, m).

Ex.24b (d^6-DMSO) δ 7.0-6.1 (4H, s), 4.1 (1H, m), 3.6 (3H,

2 x s), 3.2-2.2 (10H, m), 1.9 (3H, m), 1.6 (6H, q), 1.3 (6H, s), 1.0 (3H, m).

Ex.25 (d^6-DMSO) δ 7.7 (1H, 2 x d), 7.1 (1H, 2 x t), 4.2 (1H, m), 3.6 (3H, s), 2.8-2.5 (2H, m), 2.7 (2H, m), 1.9-1.3 (25H, m), 1.2 (3H, m).

Ex.26 (d^6-DMSO) δ 12.5 (1H, br-s), 7.2 (6H, m), 5.9 (1H, t), 4.5-4.1 (1H, m), 3.8-2.9 (6H, m), 2.7-2.2 (2H, m), 1.9 (7H, m), 1.6 (6H, q), 1.3 (6H, s).

Ex.27 (d^6-DMSO) δ 12.5 (1H, br-s), 7.6 (1H, t), 7.2 (6H, m), 4.3-4.1 (1H, m), 3.5-2.9 (6H, m), 2.8-2.2 (2H, m), 1.9 (7H, m), 1.6 (6H, q), 1.4 (6H, s).

Ex.28 (d^6-DMSO) δ 12.5 (1H, br-s), 7.6-6.9 (7H, m), 4.8-4.0 (3H, m), 3.5-2.8 (6H, m), 2.7-2.2 (2H, m), 1.9 (5H, m), 1.6 (6H, q), 1.3 (6H, m).

Ex.29 (d^6-DMSO) δ 12.5 (1H, br-s), 7.6 (1H, br s), 7.2 (6H, m), 5.0 (1H, m), 4.3-4.1 (2H, m), 3.5-2.9 (6H, m), 2.8-2.2 (4H, m), 1.9 (3H, m), 1.6 (6H, q), 1.4 (6H, s).

Ex.30 (d^6-DMSO) δ 7.2 (6H, m), 6.1 and 5.9 (1H, 2 x t), 4.5-4.1 (1H, m), 3.9-2.9 (9H, m), 2.7-2.2 (2H, m), 1.9 (7H, m), 1.6 (6H, q), 1.2 (6H, s).

Ex.31 (d^6-DMSO) δ 7.6 (1H, t), 7.2 (6H, m), 4.5-4.1 (1H, m), 3.6-2.9 (9H, m), 2.8-2.2 (2H, m), 1.9 (7H, m), 1.6 (6H, q), 1.2 (6H, s).

Ex.32 (d^6-DMSO) δ 7.6-7.2 (7H, m), 4.6-4.1 (1H, m), 3.6-2.9 (9H, m), 2.8-2.2 (2H, m), 1.9 (7H, m), 1.6 (6H, q), 1.2 (6H, s).

Ex.34 (d^6-DMSO) δ 12.5 (1H, br s), 7.2 (5H, m), 4.5-4.1 (1H, m), 3.8-2.9 (10H, m), 2.1-1.8 (7H, m), 1.6 (6H, q), 1.4 (6H, m).

Ex.35 (d^6-DMSO) δ 12.5 (1H, br s), 7.2 (5H, m), 4.2-3.9 (1H, m), 3.7-3.2 (10H, m), 2.1-1.7 (7H, m), 1.6 (6H, q), 1.2 (6H, m).

Ex.36 ($CDCl_3$) δ 7.2 (9H, m), 6.1 (1H, s), 3.3 (2H, m), 3.1 (1H, m), 2.9 (2H, m), 2.6-2.3 (2H, m), 2.1-1.9 (5H, s), 1.6 (7H, q), 1.4 (6H, m), 0.8 (1H, d).

Ex.37 (d^6-DMSO) δ 12.5 (1H, s), 8.1 (1H, t), 7.8-6.9 (10H, m), 6.9 (1H, t), 4.6 (2H, m), 4.0 (1H, m), 3.7 (2H, m),3.4-3.1 (4H, m), 2.6 (4H, m), 1.9 (7H, m), 1.6 (6H, q), 1.3 (6H, m).

Ex.38 (d^6-DMSO) δ 12.6 (1H, s), 8.3 (1H, t), 7.8-6.9 (11H, m), 4.6 (2H, m), 4.2 (1H, m), 3.8-3.1 (6H, m), 2.6 (4H, m), 1.9 (7H, m), 1.6 (6H, q), 1.4 (6H, m).

Ex.39 (d^6-DMSO) δ 7.7-7.0 (11H, m), 6.5-6.1 (2H, m), 3.5-2.6 (6H, m), 1.9 (3H, s), 1.6 (6H, q), 1.4 (6H, m).

Ex.40 (d^6-DMSO) δ 12.5 (1H, br s), 8.2-7.1 (6H, m), 4.1 (2H, m), 3.5-2.9 (6H, m), 2.8-2.2 (2H, m), 1.9 (11H, m), 1.6 (6H, q), 1.4 (6H, m), 1.1 (3H, m).

Ex.41 (d^6-DMSO) δ 12.5 (1H, br s), 7.9 (1H, t) 7.2 (5H, m), 4.2 (1H, m), 4.1 (1H, m), 3.6-2.9 (6H, m), 2.8-2.2 (2H, m), 1.9 (7H, m), 1.6 (10H, q), 1.4 (6H, m), 1.2 (3H, m).

Ex.42 (d^6-DMSO) δ 12.5 (1H, br s), 8.0 (1H, t), 7.9 (1H, t), 7.2 (4H, m), 4.2 (1H, m), 3.6-2.9 (8H, m), 2.8-2.2 (2H, m), 2.0-1.7 (11H, m), 1.6 (6H, q), 1.4 (6H, m).

Ex.43 (d^6-DMSO) δ 12.5 (1H, br s), 7.9 (1H, t) 7.2 (5H, m), 4.2 (1H, m), 4.1 (1H, m), 3.6-2.9 (6H, m), 2.8-2.2 (2H, m), 1.9 (7H, m), 1.6 (10H, q), 1.4 (6H, m), 1.2 (3H, m).

Ex.44 (d^6-DMSO) δ 12.5 (1H, br s), 8.2-7.1 (6H, m), 4.1 (2H, m), 3.5-2.9 (6H, m), 2.8-2.2 (2H, m), 1.9 (11H, m), 1.6 (6H,

q), 1.4 (6H, m), 1.1 (3H, m).

Ex.45 (d^6-DMSO) δ 12.5 (1H, br s), 8.0 (1H, m), 7.9 (1H, t), 7.2 (4H, m), 4.2 (1H, m), 3.6-2.9 (8H, m), 2.8-2.2 (2H, m), 2.0-1.7 (11H, m), 1.6 (6H, q), 1.4 (6H, m).

Ex.46 (d^6-DMSO) δ 7.9-7.0 (5H, m), 5.9 (1H, t), 3.9 (1H, m), 3.6-3.1 (8H, m), 2.6-2.2 (2H, m), 1.9 (11H, m), 1.6 (6H, q), 1.2 (6H, s).

Ex.47 (d^6-DMSO) δ 7.8-7.0 (5H, m), 5.8 (1H, t), 4.1 (2H, m), 3.6-3.1 (6H, m), 2.6-2.2 (2H, m), 1.9 (11H, m), 1.6 (6H, q), 1.2 (9H, m).

Ex.48 (d^6-DMSO) δ 7.6-7.0 (5H, m), 5.8 (1H, t), 4.0 (2H, m), 3.6-3.1 (6H, m), 2.6-2.2 (2H, m), 1.9 (11H, m), 1.6 (6H, q), 1.2 (9H, m).

Ex.49 (d^6-DMSO) δ 8.0-7.0 (5H, m), 5.7 (1H, t), 4.1 (1H, m), 3.8-3.1 (8H, m), 2.6-2.2 (2H, m), 1.9 (11H, m), 1.6 (6H, q), 1.2 (6H, m).

Ex.50 (d^6-DMSO) δ 7.5-6.9 (6H, m), 4.1 (2H, m), 3.6-3.1 (6H, m), 2.6-2.2 (2H, m), 1.9 (11H, m), 1.6 (6H, q), 1.2 (9H, m).

Ex.51 (d^6-DMSO) δ 7.9-6.9 (5H, m), 5.8 (1H, m), 4.1 (2H, m), 3.6-3.1 (6H, m), 2.6-2.2 (2H, m), 1.9 (11H, m), 1.6 (6H, q), 1.2 (9H, m).

Ex.52 (d^6-DMSO) δ 7.7-6.9 (5H, m), 6.3 and 5.8 (1H, 2xt), 4.0 (2H, m), 3.6-3.1 (8H, m), 2.6-2.2 (2H, m), 1.9 (11H, m), 1.6 (6H, q), 1.2 (9H, m).

Ex.53 (d^6-DMSO) δ 7.6-6.8 (11H, m), 6.1 (1H, s), 5.8 (1H, m), 4.0 (3H, m), 3.3-2.5 (6H, m), 1.9 (7H, m), 1.6 (6H, q), 1.2 (6H, s).

Ex.54 (d^6-DMSO) δ 11.4 (1H, br s), 7.5 (1H, t), 7.4-6.9 (4H,

m), 3.7 (3H, s), 3.6 (3H, m), 2.5 (2H, 2xdd), 1.9 (5H, m), 1.6 (6H, q), 1.3 (6H, s).

Ex.55 ($CDCl_3$) δ 13.1 (2H, br s), 9.8 (1H, s), 8.3 (1H, s), 8.2 (1H, s), 8.1 (2H, m), 7.6-6.8 (10H, m), 4.5 and 4.3 (1H, 2xm) 3.8-2.7 (10H, m), 1.9 (5H, m), 1.6 (6H, q), 1.3 (6H, m).

Ex.56 (d^6-DMSO) δ 12.0 (1H, br s), 8.0 (1H, m), 7.5-6.8 (4H, m), 4.1-3.0 (9H, m), 2.5 (2H, m), 1.9 (9H, m), 1.6 (6H, q), 1.3 (6H, m).

Ex.57 (d^6-DMSO) δ 11.3 (1H, br s), 7.5 (1H, t), 7.2-6.8 (4H, m), 3.4 (6H, m), 2.5 (2H, 2xq), 1.9 (5H, m), 1.6 (6H, q), 1.3 (6H, s).

Ex.58 ($CDCl_3$) δ 13.1 (2H, br s), 9.8 (1H, s), 8.3 (1H, s), 8.2 (1H, s), 8.1 (2H, m), 7.6-6.8 (10H, m), 4.5 and 4.3 (1H, 2xm) 3.8-2.7 (10H, m), 1.9 (3H, m), 1.6 (6H, q), 1.3 (6H, m).

Ex.59 (d^6-DMSO) δ 12.5 (1H, br s), 7.8 (1H, m), 7.3-6.7 (4H, m), 4.1-3.0 (9H, m), 2.5 (2H, m), 1.9 (7H, m), 1.6 (6H, q), 1.2 (6H, s).

Ex.60 (d^6-DMSO) δ 13.0 (2H, br s), 10.1 and 9.9 (1H, 2xs), 8.6-7.0 (16H, m), 4.6 and 4.5 (1H, 2xm) 3.4-2.0 (8H, m), 1.9 (3H, m), 1.6 (6H, q), 1.3 (6H, m).

Ex.61 (d^6-DMSO) δ 13.0 (2H, br s), 10.1 and 9.9 (1H, 2xs), 8.6-7.0 (14H, m), 4.6 and 4.5 (1H, 2xm) 3.4-1.9 (12H, m), 1.9 (3H, m), 1.6 (6H, q), 1.3 (6H, m).

Ex.62 (d^6-DMSO) δ 13.0 (2H, br s), 9.9 (1H, s), 8.4 (1H, d), 8.2 (2H, s), 8.1 (1H, s) 7.4-6.6 (12H, m), 4.5 (1H, m) 3.3-2.9 (6H, m), 2.5-2.3 (2H, m), 1.9 (3H, m), 1.6 (6H, q), 0.9 (6H, m).

Ex.63 (d^6-DMSO) δ 13.0 (2H, br s), 10.1 and 9.9 (1H, 2xs), 8.6-7.0 (14H, m), 4.6 and 4.5 (1H, 2xm) 3.4-1.9 (12H, m), 1.9 (3H, m), 1.6 (6H, q), 1.3 (6H, m).

Ex.64 (d^6-DMSO) δ 13.0 (2H, br s), 10.1 and 9.9 (1H, 2xs), 8.6-7.0 (16H, m), 4.6 and 4.5 (1H, 2xm) 3.4-2.0 (8H, m), 1.9 (3H, m), 1.6 (6H, q), 1.3 (6H, m).

Ex.65 (d^6-DMSO) δ 13.0 (2H, br s), 9.9 (1H, s), 8.4 (1H, d), 8.2 (2H, s), 8.1 (1H, s) 7.4-6.6 (12H, m), 4.5 (1H, m) 3.3-2.9 (6H, m), 2.5-2.3 (2H, m), 1.9 (3H, m), 1.6 (6H, q), 0.9 (6H, m).

Ex.66 ($CDCl_3$) δ 13.1 (2H, br s), 9.8 (1H, s), 8.3 (1H, s), 8.2 (1H, s), 8.1 (2H, m), 7.6-6.8 (10H, m), 4.5 and 4.3 (1H, 2xm) 3.8-2.7 (10H, m), 1.9 (3H, m), 1.6 (6H, q), 1.3 (6H, m).

Ex.67 (d^6-DMSO) δ 13.0 (2H, br s), 10.1 and 9.9 (1H, 2xs), 8.6-7.0 (23H, m), 4.6 and 4.5 (1H, 2xm) 3.4-2.8 (6H, m), 2.5 (2H, m).

Ex.68 (d^6-DMSO) δ 13.0 (2H, br s), 10.1 and 9.9 (1H, 2xs), 8.6-7.0 (23H, m), 4.6 and 4.5 (1H, 2xm) 3.4-2.8 (6H, m), 2.5 (2H, m).

Ex.69 (d^6-DMSO) δ 13.0 (2H, br s), 10.1 and 9.9 (1H, 2xs), 8.6-7.0 (23H, m), 4.6 and 4.5 (1H, 2xm) 3.4-2.8 (6H, m), 2.5 (2H, m).

Ex.70 (d^6-DMSO) δ 13.0 (2H, br s), 10.1 and 9.9 (1H, 2xs), 8.6-7.0 (23H, m), 4.6 and 4.5 (1H, 2xm) 3.4-2.8 (6H, m), 2.5 (2H, m).

Ex.71 ($CDCl_3$) δ 13.1 (2H, br s), 9.8 (1H, s), 8.3 (1H, s), 8.2 (1H, s), 8.1 (2H, m), 7.6-6.8 (10H, m), 4.5 and 4.3 (1H, 2xm), 3.8-2.7 (10H, m), 1.9 (5H, m), 1.6 (6H, q), 1.3 (6H, m).

Ex.72 (d^6-DMSO) δ 7.7-6.9 (5H, m), 6.3 and 5.8 (1H, 2xt), 4.0 (2H, m), 3.6-3.1 (8H, m), 2.6-2.2 (2H, m), 1.9 (11H, m), 1.6 (6H, q), 1.2 (9H, m).

The compounds of the examples were tested for binding at the CCK_B receptor in mouse cortical membranes by means of a radioligand binding assay. The procedure was as follows:

The whole brains from male mice (CD1 22-25g; Charles River) were removed and placed in ice-cold buffer (pH7.2 @ 21 ± 3°) of the following composition (mM); 10 HEPES, 130 NaCl, 4.7 KCl, 5 $MgCl_2$, 1 EDTA and containing 0.25g.l^{-1} bacitracin. The cortex was dissected, weighed and homogenised in 40ml ice-cold buffer using a Teflon-in-glass homogeniser. The homogenate was centrifuged at 39,800g for 20 min at 4°, the supernatant discarded and the pellet resuspended by homogenisation in fresh buffer. The homogenate was recentrifuged (39,800g; 20 min @ 4°) and the final pellet was resuspended in HEPES buffer to give a tissue concentration of 2mg.ml^{-1} (original wet weight).

The membranes (400ml) were incubated for 150 min at 21 ± 3° in a final volume of 0.5ml with HEPES buffer containing [^{125}I]-CCK8S (0.05ml; 200pM NEN 2200Ci.$mmol^{-1}$) and competing compound. Total and non-specific binding of [^{125}I]-CCK8S were defined using 0.05ml of buffer and 0.05ml of 10mM L-365,260, respectively. The assay was terminated by rapid filtration through pre-soaked Whatman GF/B filters using a Brandell Cell harvester. The filters were washed (3 x 3ml) with ice-cold 50mM Tris-HCl (pH7.4 @ 4°C) and bound radioactivity determined by counting (1 min.) in a gamma-counter.

The results obtained from the CCK_B assays are set out in Table 1.

TABLE 1

Example	CCK_B pK_i	Example	CCK_B pK_i
1	5.4	32	6.5
2	5.6	33	4.8
3	4.6	34	5.2
4	4.4	35	5.0
5	4.9	36	5.8
6	4.6	37	6.8
7	6.6	38	6.6
8	6.2	39	5.7
9	5.6	40	5.1
10	5.7	41	5.3
11	5.8	42	5.4
12	6.1	43	5.7
13	5.6	44	6.0
14	6.5	45	5.6
15	5.8	46	6.4
16	6.5	47	5.9
17	6.8	48	6.1
18	6.1	49	5.4
19	6.4	50	5.6
20	6.8	51	5.3
21	6.4	52	7.0
22	6.2	53	5.8
23	6.4	54	5.3
24	5.0	55	7.6
25	5.1	56	5.1
26	5.5	57	5.3
27	6.2	59	5.5
28	5.7	60	6.5
29	5.6	61	6.0
30	6.3		

The compounds of the examples were also tested for gastrin antagonist activity in an immature rat stomach assay. The procedure was as follows:

The oesophagus of immature rats (33-50 g, ca. 21 days old) was ligated at the level of the cardiac sphincter and the duodenal sphincter was cannulated. The stomach was excised and flushed with ca. 1 ml of unbuffered physiological saline solution. The fundus was punctured and cannulated. A further 4-5 ml of unbuffered solution was flushed through the stomach to ensure the preparation was not leaking. The stomach was lowered into a jacketed organ bath containing 40 ml of buffered solution containing $3x10^{-8}$M 5-methyl-furmethide, maintained at 37° and gassed vigorously with 95% O_2/ 5% CO_2. The stomach was continuously perfused at a rate of 1 ml min^{-1} with unbuffered solution gassed with 100% O_2 with the perfusate passing over an internally referenced pH-electrode fixed 12 cm above the stomach.

After 120 min of stabilisation the drugs were added directly to the serosal solution in the organ bath and after a further 60 min cumulative pentagastrin dose-response curves were started. Changes in acid secretion were monitored and the curves analysed according to Black et.al., Br. J. Pharmacol., 1985, 86, 581.

The results obtained from the gastrin assays are set out in Table 2.

TABLE 2

Example	Gastrin pK_B	Example	Gastrin pK_B
2	5.9	24	5.9
7	6.5	25	6.0
8	6.3	26	5.9
9	6.1	27	6.5
10	5.8	29	5.7
11	5.2	30	6.4
12	5.3	31	6.3
13	5.5	37	6.3
15	5.5	38	6.2
16	6.3	39	5.6
17	6.2	54	6.1
18	6.0	55	6.9
19	5.8	56	5.6
22	6.7	60	7.3
23	6.5	61	6.6

The compounds of the examples were also tested in a CCK_A binding assay as follows:

The pancreatata were removed from male guinea-pigs (200-300g; Dunkin Hartley) and placed in ice-cold HEPES buffer (pH 7.2 @ 21 ± 3°). The pancreatata were homogenised in 40 ml ice-cold HEPES buffer using a polytron (Brinkmann, PT10, setting 10) 4 x 1 second. The homogenate was centrifuged at 39,800g for 15 min at 4°. The supernatant was discarded and the pellet re-suspended using a Teflon-in-glass homogeniser in 20 volumes of fresh buffer and re-centrifuged as above. The final pellet was re-suspended using a Teflon-in-glass homogeniser to a tissue concentration of 1 $mg.ml^{-1}$ (original wet weight), and filtered through 500 µm pore-size Nytex mesh.

The membranes (400µl; containing 0.375 µM PD134,308) are

incubated for 150 minutes at 21 ± 3° in a final volume of 0.5ml with HEPES buffer containing [^{125}I]-CCK$_8$(S) (50µl; 200pM) and competing compound. Total and non-specific binding of [^{125}I]-CCK$_8$(S) are defined using 50µl of buffer and 50µl of 100nM L-364,718 respectively. The assay is terminated by rapid filtration through pre-soaked Whatman GF/B filters using a Brandell Cell Harvester. The filters were washed (3 x 3ml) with ice-cold 50mM Tris HCl (pH 7.4 at 4°) and bound radioactivity is determined by counting (1 min) in a gamma counter.

The results are set out in Table 3.

TABLE 3

Example	CCK$_A$ pK$_i$	Example	CCK$_A$ pK$_i$
17	6.3	37	5.5
18	6.0	38	5.1
34	5.1	41	5.1
35	4.8	42	5.2
36	5.4	43	5.0

CLAIMS

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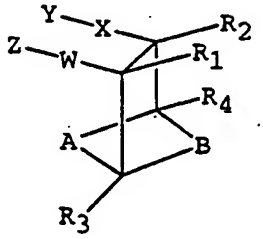

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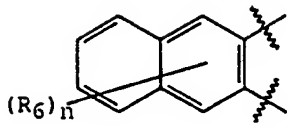
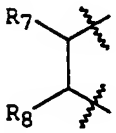
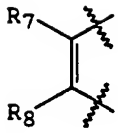
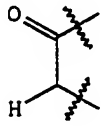
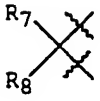
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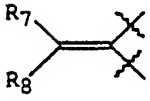

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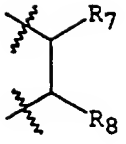
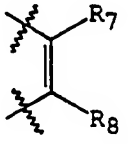
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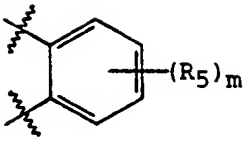
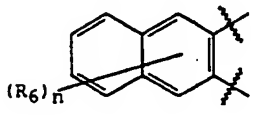
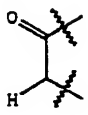
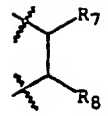
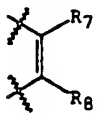
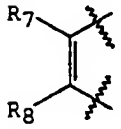
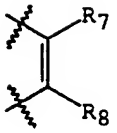


(provided that

A is not  or 

when B is  or  , and

A is not  when B is )

wherein W is a carbonyl, sulphonyl or sulphinyl group, and

X is a carbonyl, sulphonyl or sulphinyl group or $-C(O)-CH_2-$ (in which the carbonyl group is bonded to Y), provided that at least one of W and X contains carbonyl,

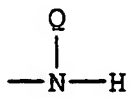
Y is R_9-O- or $R_9-N(R_{10})-$ (wherein R_9 is H or C_1 to C_{15} hydrocarbyl, up to two carbon atoms of the hydrocarbyl moiety optionally being replaced by a nitrogen, oxygen or sulphur atom provided that Y does not contain a -O-O- group, and R_{10} is H, C_1 to C_3 alkyl, carboxymethyl or esterified carboxymethyl),

Z is selected from

i) $-O-R_{11}$

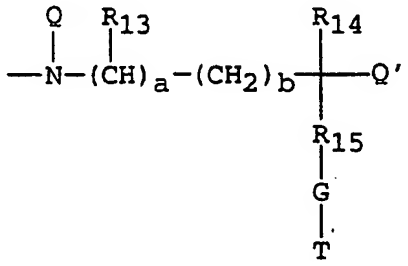
wherein R_{11} is H, C_1 to C_5 alkyl, phenyl, substituted phenyl, benzyl or substituted benzyl;

ii)



wherein Q is H, C_1 to C_5 hydrocarbyl, or $-R_{12}-U$, wherein R_{12} is a bond or C_1 to C_3 alkylene and U is aryl, substituted aryl, heterocyclic, or substituted heterocyclic,

iii)



wherein a is 0 or 1 and b is from 0 to 3,

R_{13} is H or methyl,

R_{14} is H or methyl; or R_{14} is CH_2= and Q' is absent; or R_{13} and R_{14} are linked to form a 3- to 7-membered ring,

R_{15} is a bond or C_1 to C_5 hydrocarbylene,

G is a bond, -CHOH- or -C(O)-

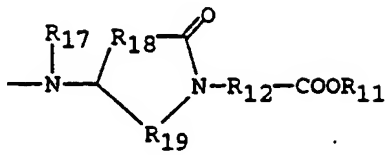
Q' is as recited above for Q or $-R_{12}-(C(O))_d-L-(C(O))_e-R_{11}$ (wherein R_{11} and R_{12} are as defined above, L is O, S or $-N(R_{16})-$, in which R_{16} is as defined above for R_{10}, and d and e are 0 or 1, provided that d+e<2); or Q' and R_{14}, together with the carbon atom to which they are attached, form a 3- to 7-membered ring,

Q is as defined above; or Q and R_{14} together form a group of the formula $-(CH_2)_f-V-(CH_2)_g-$ wherein V is -S-, -S(O)-, $-S(O)_2-$, $-CH_2-$, -CHOH- or -C(O)-, f is from 0 to 2 and g is from 0 to 3; or, when Q' is $-R_{12}-U$ and U is an aromatic group, Q may additionally represent a methylene link to U, which link is *ortho* to the R_{12} link to U,

T is H, cyano, C_1 to C_4 alkyl, $-CH_2OH$, carboxy,

esterified carboxy, amidated carboxy or tetrazolyl; or

iv)



wherein R_{11} and R_{12} are as defined above, R_{17} is as defined above for R_{10}, and R_{18} and R_{19} are independently a bond or C_1 to C_3 alkylene, provided that R_{18} and R_{19} together provide from 2 to 4 carbon atoms in the ring,

or Z is absent and W is H,

R_1 is H, methyl, halo, carboxy, esterified carboxy, amidated carboxy, tetrazolyl, carboxymethyl, esterified carboxymethyl, amidated carboxymethyl or tetrazolylmethyl,

R_2 is selected from the groups recited above for R_1; or, when Z is absent and W is H, R_2 may additionally represent -C(O)-Z' wherein Z' is selected from the groups recited above for Z; or R_1 and R_2 together form a second bond between the carbon atoms to which they are attached,

R_3 and R_4 are independently selected from hydrogen, halo, amino, nitro, cyano, sulphamoyl, C_1 to C_3 alkyl, C_1 to C_3 alkoxy, carboxy, esterified carboxy, amidated carboxy or tetrazolyl,

R_5 and R_6 (or each R_5 and R_6 group, when m or n is 2 or more) are independently selected from halo, amino, nitro, cyano, sulphamoyl, C_1 to C_3 alkyl, C_1 to C_3 alkoxy, carboxy, esterified carboxy, amidated

carboxy or tetrazolyl,

R_7 and R_8 are independently selected from hydrogen, C_1 to C_6 alkyl, phenyl, benzyl, substituted phenyl and substituted benzyl,

m is from 0 to 4, provided that m is not more than 2 unless R_5 is exclusively halo,

n is from 0 to 4, provided that n is not more than 2 unless R_6 is exclusively halo, and

pharmaceutically acceptable salts thereof.

2. A compound according to claim 1 wherein R_9 is C_6 to C_8 straight or branched chain alkyl, or R_{29}-$(CH_2)_p$-, wherein R_{29} is selected from phenyl, 1-naphthyl, 2-naphthyl, indolyl, norbornyl, adamantyl or cyclohexyl, and p is from 0 to 3.

3. A compound according to claim 1 or claim 2 wherein W is carbonyl and X is sulphonyl.

4. A compound according to claim 1 or claim 2 wherein W is carbonyl and X is carbonyl.

5. A compound according to claim 1 or claim 2 wherein W is sulphonyl and X is carbonyl.

6. A compound according to any preceding claim wherein R_7 and R_8 are both H.

7. A compound according to any preceding claim wherein m is 0.

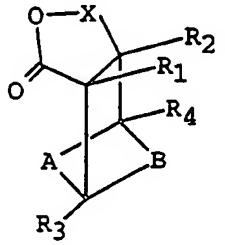
8. A compound selected from cis-7-(2R-carboxymethyl-aminocarbonyl-pyrrolidinocarbonyl)-8-(1-adamantylmethyl-aminocarbonyl)-2,3-benzo-5,6-(2,3-naphtho)bicyclo-[2.2.2]octane, cis-endo-7-(2S-(1R-carboxyethylamino-

carbonylmethyl)-pyrrolidinocarbonyl)-8-(1-adamantyl-methylaminocarbonyl)-2,3-benzobicyclo[2.2.2]octane, (±)-1-methoxycarbonyl-endo-cis-6-(1S-(3,5-dicarboxyphenylamino-carbonyl)-2-phenylethylaminocarbonyl)-7-(1-adamantylmethyl-aminocarbonyl)-2,3-benzobicyclo[2.2.1]heptane, (±)-endo-cis-6-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethyl-aminocarbonyl)-7-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.1]heptane, exo-cis-7-(1S-(3,5-dicarboxy-phenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene, exo-cis-7-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-adamantylmethylamino-carbonyl)-2,3-benzobicyclo[2.2.2]octane, endo-cis-7-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylamino-carbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzo-bicyclo[2.2.2]oct-2-ene, endo-cis-7-(1S-(3,5-dicarboxy-phenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.2]octane, exo-cis-7-(1R-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene, endo-cis-7-(1R-(3,5-dicarboxy-phenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene, (±)-endo-cis-6-(1R-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-7-(1-adamantylmethylamino-carbonyl)-2,3-benzobicyclo[2.2.1]heptane, exo-cis-7-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylamino-carbonyl)-8-(1-naphthylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene, exo-cis-7-(1R-(3,5-dicarboxy-phenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-naphthylmethylaminocarbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene, endo-cis-7-(1S-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylaminocarbonyl)-8-(1-naphthylmethylamino-carbonyl)-5,6-benzobicyclo[2.2.2]oct-2-ene, endo-cis-7-(1R-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylamino-carbonyl)-8-(1-naphthylmethylaminocarbonyl)-5,6-benzo-bicyclo[2.2.2]oct-2-ene, (±)-1-methoxycarbonyl-endo-cis-6-(1R-(3,5-dicarboxyphenylaminocarbonyl)-2-phenyl-ethylamino-

carbonyl)-7-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.1]heptane and cis-exo-7-(2S-(1R-carboxyethylaminocarbonylmethyl)-pyrrolidinocarbonyl)-8-(1-adamantylmethylaminocarbonyl)-2,3-benzobicyclo[2.2.2]octane

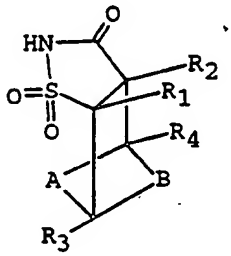
9. A pharmaceutical composition comprising a compound according to any preceding claim, together with a pharmaceutically acceptable diluent or carrier.

10. A method of making a compound according to claim 1 wherein W is carbonyl, said method including the step of reacting a compound of the formula



with a compound of formula YH.

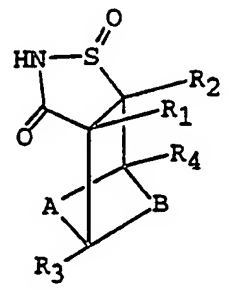
11. A method of making a compound according to claim 1 wherein W is sulphonyl, said method comprising the step of reacting a compound of the formula



with a compound of the formula R_9-Hal, wherein Hal represents a halogen atom, and then reacting the product with an alkoxide.

12. A method of making a compound according to claim 1

wherein W or X is sulphoxide, said method comprising the step of reacting a compound of the formula:



with a compound of the formula R_9-Hal, and then reacting the product with an alkoxide.

13. A method of making a pharmaceutical composition according to claim 9, comprising mixing a compound according to any of claims 1 to 8 with a pharmaceutically acceptable diluent or carrier.

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 93/01301

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 C07C233/63; C07C233/58; C07C237/22; C07K5/06
A61K31/16; C07D209/20; C07D207/16; A61K31/395

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	C07C ; C07K

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	EP,A,0 455 195 (SEARLE, G. D., AND CO.; USA (US)) 6 November 1991 see page 12, line 31 - page 14, line 25; examples VI,VII,X,XI	1,7
X	US,A,3 320 267 (G.I. POOS) 16 May 1967 see examples III,XII	1,4,6,7
X	J. ORG. CHEM. (JOCEAH); 67; VOL.32 (1); PP.69-72 'Diels-Alder reactions of naphthacene' see page 70; table I see page 71, right column	1,7

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° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
16 SEPTEMBER 1993	29.09.93
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	PAUWELS G.R.A.

III. DOCUMENTS C NSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	INDIAN J. CHEM., SECT. B (IJSBDB,03764699); 84; VOL.23B (7); PP.631-4 'PMR spectral studies of Diels-Alder adducts: anthracene-crotonic acid, anthracene-fumaric acid and .beta.-naphthol-fumaric acid' see page 632 ---	1,4,7
X	PATENT ABSTRACTS OF JAPAN vol. 014, no. 068 (C-0686)8 February 1990 & JP,A,12 90 660 (NIPPON OIL & FATS CO LTD) see abstract ---	1,2,4,6, 7
X	PHARMAZIE (PHARAT); 76; VOL.31 (11); PP.804-11 'Untersuchungen zum Metabolismus des zentralen Analepticums Endomid bei der Ratte' see page 805: Schema 1 ---	1,4,6,7
X	MONATSH. CHEM. (MOCHAP); 71; VOL.102 (2); PP.609-21 'Thalidomid-Analoga. 3' see page 611: compounds 5, 9, 13 see page 615 - page 621 ---	1,4,6,7, 10
X	BULL. CHEM. SOC. JPN. (BCSJA8); 64; VOL.37,; PP.1175-80 'Beiträge zur Umlagerung der Cyclischen Imidoester' see page 1178; table III ---	1,4,6,7
X	LIEBIGS ANN. CHEM. (LACHDL,01702041); 90; (7); PP.671-80 'Aminosäureester als chirale Hilfsgruppen in Lewis-Säure-katalysierten Diels-Alder-Reaktionen' see page 678 - page 679 ---	1
X	J. ORG. CHEM. (JOCEAH,00223263); 88; VOL.53 (26); PP.6133-6 '(S)-Proline benzyl ester as chiral auxiliary in Lewis acid catalyzed asymmetric Diels-Alder reactions' see page 6133: Scheme I see page 6135 - page 6136 ---	1,4,6,7
X	MONATSHEFTE FUR CHEMIE. vol. 96, no. 6, 1965, WIEN AT pages 1928 - 1933 H. KOCH ET AL. 'Über alkylierte Amide bicyclischer Dicarbonsäuren, 4' see page 1931 - page 1933 ---	1,2,4,6, 7

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INTERNATIONAL SEARCH REPORT

.ernational application No.
PCT/GB93/01301

Box I Observati ns where certain claims were found unsearchable (Continuation f item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

./.

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

B x II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searches without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/

The formulation of claim 1 covers a wide variety of compounds, containing a large number of different polycyclic structures, each optionally substituted at different positions by substituents of very different nature, such e.g. carboxylic acids, carbonamides, nitriles, sulfinic acids, sulfonamides, heterocyclic groups and peptides. It is therefore not possible to perform an exhaustive search within a reasonable time limit. The search has been carried out on the basis of the synthesised examples (Guidelines B-III, 3.7).

Furthermore, the search revealed such a large number of particularly relevant documents, that it not practicable to cite all of them. The search report contains a representative sample of the revealed documents.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9301301 SA 75348

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 16/09/93
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A-0455195	06-11-91	US-A-	5089506	18-02-92
		JP-A-	4225969	14-08-92
		US-A-	5215992	01-06-93
US-A-3320267		None		
EP-A-0037644	14-10-81	US-A-	4319036	09-03-82
		US-A-	4284824	18-08-81
		US-A-	4312888	26-01-82
		US-A-	4324912	13-04-82
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		US-A-	4388207	14-06-83
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		US-A-	4329373	11-05-82
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		AU-A-	2273088	23-03-89
		JP-A-	1113351	02-05-89
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EP-A-0405537	02-01-91	AU-A-	5962890	17-01-91
		CN-A-	1049165	13-02-91
		EP-A-	0479910	15-04-92
		JP-T-	4506079	22-10-92
		WO-A-	9100274	10-01-91